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SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

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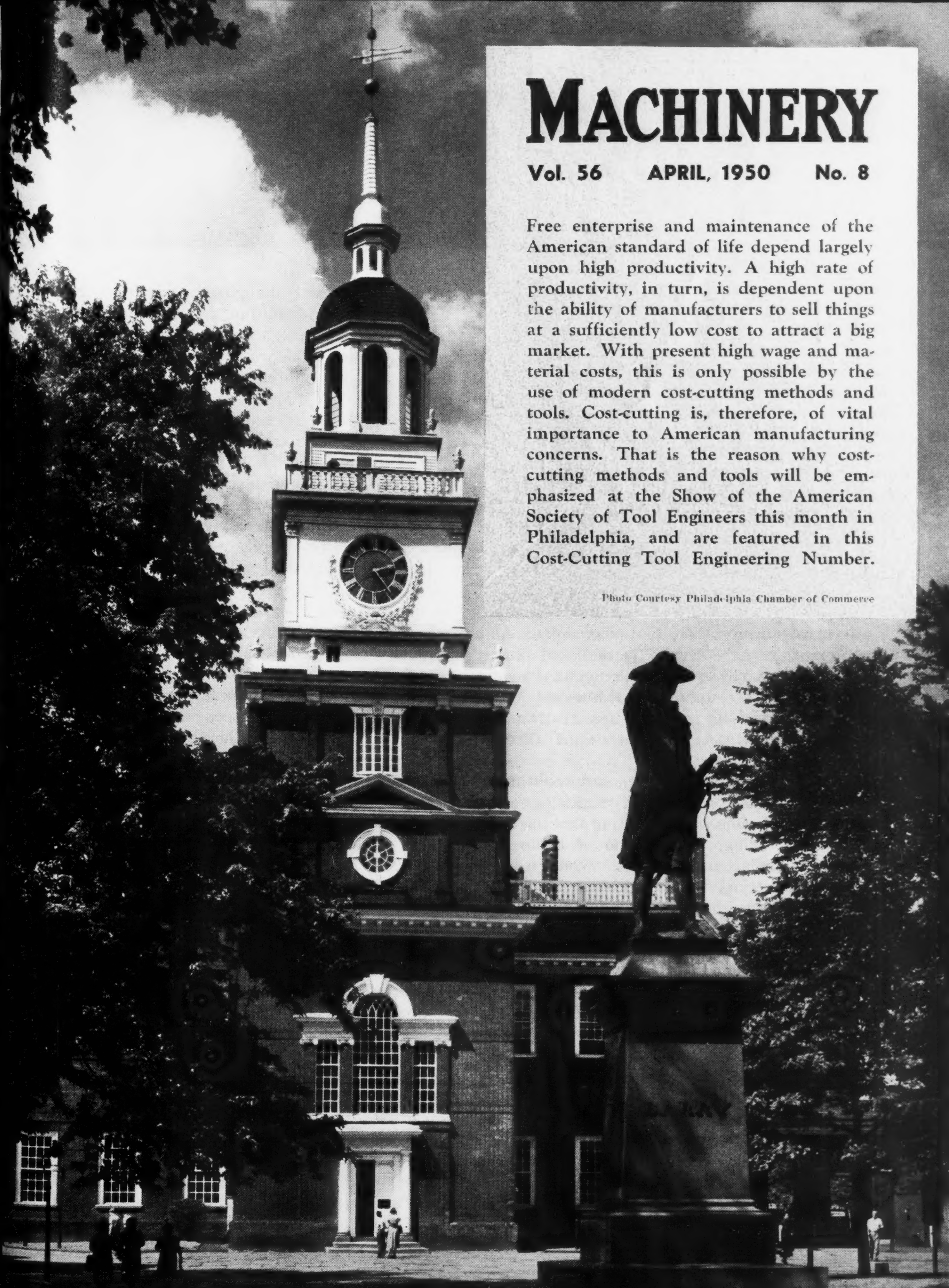

MACHINERY

Vol. 56 APRIL, 1950 No. 8

Free enterprise and maintenance of the American standard of life depend largely upon high productivity. A high rate of productivity, in turn, is dependent upon the ability of manufacturers to sell things at a sufficiently low cost to attract a big market. With present high wage and material costs, this is only possible by the use of modern cost-cutting methods and tools. Cost-cutting is, therefore, of vital importance to American manufacturing concerns. That is the reason why cost-cutting methods and tools will be emphasized at the Show of the American Society of Tool Engineers this month in Philadelphia, and are featured in this Cost-Cutting Tool Engineering Number.

Photo Courtesy Philadelphia Chamber of Commerce

The Tool Engineer—Brains of

NOT since the early days of World War II has the tool engineer been faced with as great a task as that which confronts him today. His, in a large measure, is the responsibility within industry of finding the ways and means to combat and counteract the inflationary trend in our Western civilization.

This era of inflation through which the western world has been going is no less real because it has been less violent than similar periods in past decades. Somehow or other we must find ways and means of halting the trend, and our best bet is by cutting costs, not the least of which are our industrial production costs.

When we say that we must cut production costs, we are not talking about going back to prewar prices, desirable as that may seem. As a matter of fact, the terms "prices" and "costs" are not necessarily synonymous in our economy. From the buyer's standpoint, a five-cent Mazda Christmas tree bulb is usually less costly in the long run than the three-for-a-dime Oriental imitations.

Similarly, in manufacturing, cost is not measured just by dollars expended. Value must also be considered. One way of putting it is that cost, in manufacturing, is the ratio of dollars expended to dollar value added. When we talk about cost-cutting, we are speaking in relative terms—reducing the ratio of what we spend to how much value we add when we manufacture an article out of raw materials.

In some cases, cost-cutting may mean lower prices. In other cases, it will mean holding the price line and giving greater value. In still others, it may mean something like selling a two-pants suit for $55 instead of selling a suit with one pair for $50—a higher price but a low overall cost to the buyer.

So, if we are starting out to cut costs, we can do it either by reducing the number of dollars it costs to give us a certain increase in manufactured value or we can increase the amount of value for the same cost. If we are really good, we can decrease the expenditures and increase the value at the same time.

Where does the tool engineer come in on this? Very simply. By definition, a tool engineer is an individual whose job it is to select the processes and equipment—the ways and means—of producing almost anything, from a loaf of bread to an automobile. It doesn't really make much difference what his formal title is. Obviously, if the tool engineer doesn't cut processing costs or doesn't make it possible to get more total dollar value on the shipping platform for a given expenditure, he isn't doing his job. He enters into every phase of manufacturing, as a simple analysis of expenditures quickly reveals.

In general, manufacturing costs consist of (1) labor; (2) materials; (3) interest on capital invested; and (4) overhead and profits.

Not much can be done about reducing labor costs on a per-hour basis. Rather it is necessary to tackle labor costs on a so-much-per-piece basis. It is up to the tool engineer to provide the ways and means with which productivity per man-hour can be increased. Those ways and means usually consist of physical things—more effective machines, machine accessories, tools, materials-handling devices, inspection equipment, and so on.

Can the tool engineer do anything about material costs? Certainly he can and he has. How about the way the stove industry cut down on the amount of steel required per stove by switching to resistance welding for fabrication? Lighter gages of metal are used and a stronger structure is obtained.

Interest on capital invested? Here's where the tool engineer really has an opportunity to prove his capabilities. He won't recommend buying any kind of equipment to cut costs unless it pays for itself in from six months to three years, depending on the nature of the equipment and the job it does. Where can you buy good stocks or bonds that will pay you 33 1/3 to 200 per cent interest on your money?

Inventory of materials in process also represents an investment of money. The longer it takes raw material to become a fabricated product, the more it costs. Any time that material

Mass Production

By ROBERT B. DOUGLAS, President
American Society of Tool Engineers

is idle in your factory, it is costing money. Idle time is all time during which no value is being added to the material. A casting aging out in the yard is not lying idle, because it is acquiring value. But the same casting lying around between machining operations is costing money, even if it is on a pallet being hauled from one machine to another. And added to that is the cost of paying somebody to haul it around—paying somebody to do something that adds no value to the part. To reduce such costs is another phase of the tool engineer's job.

When it comes to overhead and profits, it is obvious that management of both big and little business must take maximum advantage of tool engineering if it is to continue making profits in the years to come.

The tool engineer's job today is to (1) cut the labor time per piece by increasing labor productivity; (2) cut materials costs by establishing better methods; (3) cut idle time on parts by better materials-handling methods; and (4) insure profits by doing all three.

There are two principles that the tool engineer can apply in going at his job: (1) Don't use physical effort if some kind of machine can do the work better, quicker, and for less money. (2) Cut down all possible idle time of each part in process.

Just how far tool engineering should be applied to reduce physical effort by mechanization depends, of course, on the nature of the products, quantities required, and similar factors. But in every plant—no matter how large or small—there are always new ways of doing the same things better and for less money. The job is to locate the points where savings are worth while and do something about them.

Where can we substitute mechanical power for physical effort? That lathe over there, for instance. How about putting a pneumatic or hydraulic chuck on it? Quicker, more positive, less guesswork, more pieces per hour. Maybe we could put carbide tools on it and eliminate the physical effort of frequent tool removal and resetting. We would probably have to put a larger motor on it and tighten it up all over, but it would turn out more work per dollar invested. We would be cutting faster and the value added to each piece would be costing us less.

Yes, but won't the operator object to having to load more pieces per hour? How about that business of "speed up"? Not if we make the job easier for the operator at the same time. Perhaps we can use automatic loading? Just drop the parts on the chute. That will do the trick.

Wait a minute; if we are going to load automatically, maybe we can just transfer the parts to the grinder as they come off the lathe. Then we will eliminate all that handling between the two machines—more physical effort will be saved and more idle time on the parts eliminated. Of course, there is no point in tying the two machines together if the outputs of both machines aren't equal. But there may be a machine available that will provide balanced output. Check into it.

Machine "down time" is becoming more and more vital. The more we automatize, the more important "down time" becomes. It is fortunate

that the Joint Industry Conference was able to develop a code for machine design that would simplify maintenance and reduce its cost. When new machines are required, the tool engineer will do well to check how closely the machines conform to J.I.C. hydraulic and electric standards.

Selecting the physical means of production—that is, the kind of machine, chuck, transfer mechanism, and so on—is really the easiest part of the tool engineer's job. The big job is visualizing the process before equipment is bought and considering how it will tie in with other operations. Here we arrive at the overworked term "know how." The top-notch tool engineer will tell you he hasn't any "know how" that amounts to much. "Know how" is his knowledge and experience of yesterday and today. The things that are going to be needed tomorrow to cut costs aren't universal "know how" yet—they are the dreams that still have to be put into practice.

This doesn't imply that every tool engineer must be an inventive genius. He doesn't have to rely on himself alone for ideas. For example, he can obtain many ideas from the suppliers who call on him. Recently one of the largest manufacturing organizations in this country almost made an about-face in its purchasing practices. Where the trend previously had been to make as many things as possible themselves, they now are turning more and more to the outside supplier. On one group of tools, the company found that, even if it saved $75,000 a year on paper by making the tools, it was losing many times that amount in increased cost per piece produced with the tools. The tools were all right as tools; they just weren't being applied as well as they might have been. The company learned that it had been depriving itself of cost-cutting technical advice from outside producers of such equipment. And that is not an isolated instance.

Many of our best tool engineers today are in the plants of the suppliers of equipment and tools. We can't afford to ignore their potential contribution to cutting our costs. Those contributions go far beyond the physical items their companies produce. A machine or a process is a means to an end. It is not an end in itself.

The development of transfer machines is leading more and more to special-purpose machines rather than to single-purpose or multiple-purpose machines. It enables the manufacturer to take simpler forms of machines with lower change-over costs and tie them together with transfer mechanisms. The result is that while the complete machine is single-purpose in nature and complex, its individual components are easily adapted to other purposes or modified when products are changed.

As a matter of fact, in recent years it has become hard in many cases to tell where a standard machine ends and a special one begins. In general, the trend has been toward greater and greater standardization of components and the combining of these in all kinds of ways to get different results. In one line of broaching machines, we find that the same columns and bases are used in machines having different functions; the cylinders and pumps for machines of the same capacity are interchangeable, regardless of what the machine does. Electric controls such as relays and limit switches are so standardized that you can add or subtract a couple without difficulty if you want a machine to do something special during its cycle. The same is true of hydraulic control units.

It's a good thing that we got away from our over-zealous "streamlining" phase. We've stopped thinking of machines as complete entities. We're more willing to hang something on the outside if that is where it should be. This doesn't mean

we have to ignore eye appeal, but we can leave the "streamlining" to the last. There's generally some way of figuring out how to make a machine look better after you get it to do exactly what you want.

Another trend worth noting is the changing attitude toward excess machine capacity. Suppose you need an output of twenty-five parts per hour and you have an option of two machines—one that will give you twenty-five parts and one which will give you fifty. Frequently it is better economy to install the machine with the excess capacity, running it long enough to give the needed production and then transferring the operator to another job. The idle machine costs less in interest on capital than it would cost to keep the operator on that one job full time.

Another thing, in figuring cost reductions possible with new equipment, two factors frequently overlooked are power costs and tool costs. There are instances where savings in tool inventory and tool maintenance effected through the purchase of a new machine are even greater than the saving in direct labor. In one case, the reduction in tool inventory and tool grinding costs during the first year amounted to more than $11,000—over half the cost of the new machine.

Similarly, there are instances where spectacular savings in labor costs are accompanied by similar reductions in power cost. In one case, the saving in direct labor due to a new gear-cutting machine was a little over $5000. At the same time, the machine cut power costs by over $4000.

In figuring cost reductions, however, don't figure on asking the operator to do more work. Even if you could get him to do it, it would hardly be wise. The most costly investment in any shop from the standpoint of capital investment (training) and upkeep (wages) is the workman. Next to him, the investment in machines is much less important. A good machine plus a reasonably efficient machine tender represents a far more economical and profitable combination than an operator working his head off with obsolete and unsuitable machines or tooling.

Most large manufacturers realized the truth of this axiom some time ago and began to rely more and more on bettter equipment to raise worker productivity without increasing physical effort. But the smaller or medium-sized plant, scheduling shorter and perhaps more varied production runs, very often does not appreciate the economies of the same situation in his own plant. He does not realize that a couple of hours of additional productive or non-productive labor on a job are just as detrimental to his profit picture as a hundred hours to the larger producer.

Those wasted hours—a couple here, a couple there—add up fast in small shops. They frequently spell the difference between a profit or a loss on a particular job. If the condition exists on most jobs, it can put the company out of business. How many such non-productive hours does it take to pay for equipment which will eliminate the waste and thereafter contribute to even further savings?

Production runs in the millions are not necessary to justify faster, better, and more flexible tooling and equipment. It is particularly in the shorter run plants—the smaller companies—that cost reduction is most needed. Such plants are the foundation of every industry. Progressive tool engineering can be applied there as well as in the mass production industries. The physical items—machines and tools—may not be the same, but the result is.

We've got to substitute machine labor for physical effort. We've got to substitute cost-cutting ideas for griping about costs.

There's Profit in Automatic Gaging

By A. SANFORD, Sales Engineer
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Progressive Steps that can be Employed to Decrease Inspection Costs—from the Simple Application of Indicator Gages to the Use of Complex Machines that Automatically Position the Parts, Measure Their Size, and Segregate Them into Various Classifications

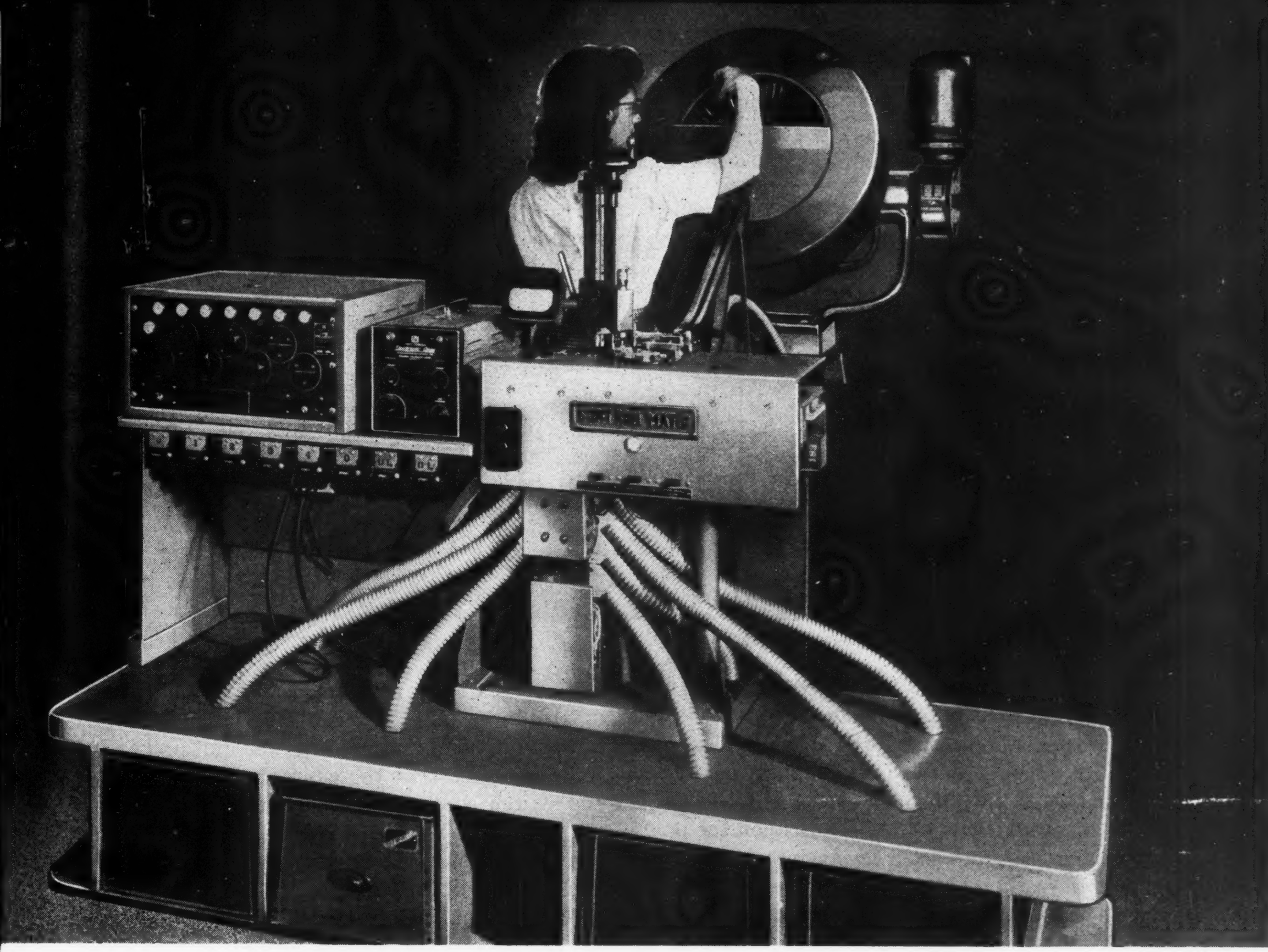
IN every well run plant there is need for inspection, not only to insure proper assembly of components, but also to maintain the customer's good will and respect for the quality of the product. For years it has been a dream of management, which has seen many dollars "wasted" on inspection, to eliminate the need for inspection or to find less expensive means of doing it.

In many instances, where every part must be held within certain limits or where parts have to be separated into groups to insure subsequent fits with mating parts, it is not possible to eliminate the sorting operation. This is especially true where parts are so assembled that non-destructive disassembly cannot be accomplished. In some cases, it is possible to hold quality levels to predetermined percentages by means of a statistical quality control system. Where the quality of incoming material or parts, number of parts, or variety of vendors requires the taking of large quality control samples, an appreciable amount of money may be spent on inspection work. When quality control methods cannot be used for various reasons, and 100 per cent inspection is necessary, management has been forced to find less expensive methods of inspection. One possible approach to the problem is further use of automatic or semi-automatic inspection machines.

In general, it can be said that any part that can be measured by means of an indicator or "Go" and "No Go" gage without an elaborate set-up can be handled to advantage on a semi-automatic or automatic gaging machine. This is a very broad statement, and an example of the possible methods of measuring a particular part might help in understanding possible approaches to the inspection problem.

For example, let us consider a small, double-ended chain rivet (Fig. 1). This is a screw machine product produced by a number of vendors and supplied to the chain manufacturer. The rivets are used at the rate of approximately one million per month. In the final assembly, the two ends act as bearings. The ends of the rivet are upset over the mating part, thus making a permanent assembly. The rivets are assembled into chains in a continuous automatic punch press operation. If diameters *A* and *B* are over size, if fillets *D* are too large, or if the center thickness *C* is too great, the rivets can still be fed through the automatic assembling press, but the completed chain will be too stiff. Conversely, if the dimensions are under size, the rivets can be assembled, but the chain pivots will be too loose. It is apparent, therefore, that both diameters *A* and *B*, width *C*, and fillets *D* must be within the specified tolerances to obtain a satisfactory product.

Even with a part having multiple critical dimensions, such as this, it is possible to use a series of "Go" and "No Go" snap gages or a micrometer to obtain the desired quality level.



However, if each part had to be checked by hand, the cost of inspecting a million a month would be tremendous. Besides the inspection cost, there is the possibility of human error in checking by hand.

A less expensive method would involve the use of a special dial indicator fixture to measure the two end diameters simultaneously. Such a fixture, shown in Fig. 2, would reduce inspection time by approximately one-third. With a gage of this type, the operator inserts, measures, and removes pieces one after the other. When the indicators show that a part is not within the specified tolerance, the inspector removes it and drops it into a scrap box. This method, while decreasing the inspection time considerably and eliminating the chance of human error due to "feel," is still subject to improvement.

By proper gage design and the addition of several link-motion transfer units, usually called pantographs, it is possible to build a single gage that will check four characteristics of a part such as the double-ended chain rivet at one loading. The pantograph, several of which are seen on the gage in Fig. 3, consists of two parallel steel blocks connected at each corner by flat parallel springs. In use, one of the blocks is anchored to the base of the gage, and the other, which is the movable portion of the pantograph, carries the gaging contact and transmits size variations to the indicator.

A properly designed gage using pantographs as described will eliminate errors caused by the "feel" of the operator. In addition to the improved accuracy obtained, gaging time, compared to that required for using a micrometer or snap gage, will be reduced by a minimum of two-thirds. While this method provides a considerable saving and would be adequate for many parts not produced in tremendous quantities, it still leaves room for improvement.

In using a micrometer or snap gage, there are two major sources of error. First, there is a variation in the "feel" of different operators. This may result in one accepting parts that would be rejected by another. The second possible error is caused by fatigue, usually occurring late in the shift, where the operator meas-

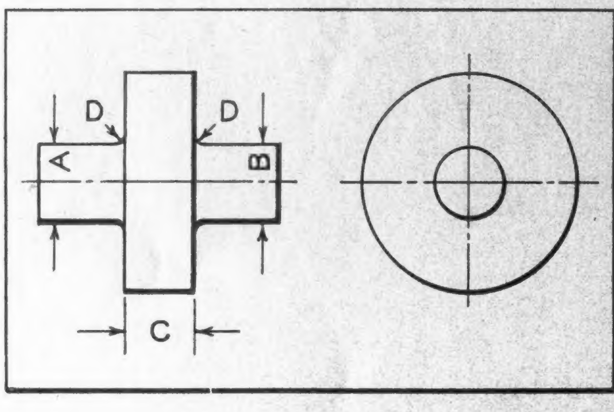


Fig. 1. Diameters (A) and (B), width (C), and fillets (D) of this small, double-ended rivet must be maintained within specified tolerances in order to obtain satisfactory assembled chains

ures the parts correctly but does not sort them properly, depositing the gaged parts in the wrong disposal box. With the specially designed indicator gage, errors caused by "feel" have been eliminated, but the proper sorting of the parts is not insured. This still depends upon the operator's alertness and accuracy in interpreting the indicator readings.

One way of minimizing the effects of fatigue or inattention is to add an automatic signaling device to the multiple indicator gage. Such a signaling device can be made to flash a light, thus informing the operator as to the size of the part. The operator does no interpreting. It is human nature to shade dial indicator readings slightly —allowing a little more than the specified limits. When the gage does the interpreting, the operator can no longer do such shading.

One of the simplest of such signaling devices consists basically of a pair of switches mounted in a housing especially designed to be attached to the back of an indicator. It is used with a small power unit, which also carries the signal lights. The combination of power unit and switch is designed so that the current passing through the switch contacts is only a few milli-amperes at very low voltage. This eliminates arcing, burning or sticking of the switch contact, and contributes toward the repetitive measurement of dimensional differences of only 0.000025 inch. The combination has the further advantage of being able to give a visible size indication, so that a qualitative size analysis can be made.

If one of these switching devices is added to each of the indicators on a multiple-indicator gage, the operation is further simplified. The operator still places the part in the gage, and after the operation, has to put it in the correct disposal box. Responsibility of the operator for reading and interpreting four indicators has been eliminated. The operator now watches only a single light. If the light is red, the part is over size; if amber, it is under size; and if green, the part is within the required limits. An example of this type of gage is shown in Fig. 4.

While the inspection of the rivet has been greatly simplified, and the cost reduced considerably, the operator still has some responsibility. The part must be put into the correct tote box in accordance with the indication of the light. It is not too difficult, however, to add a solenoid-

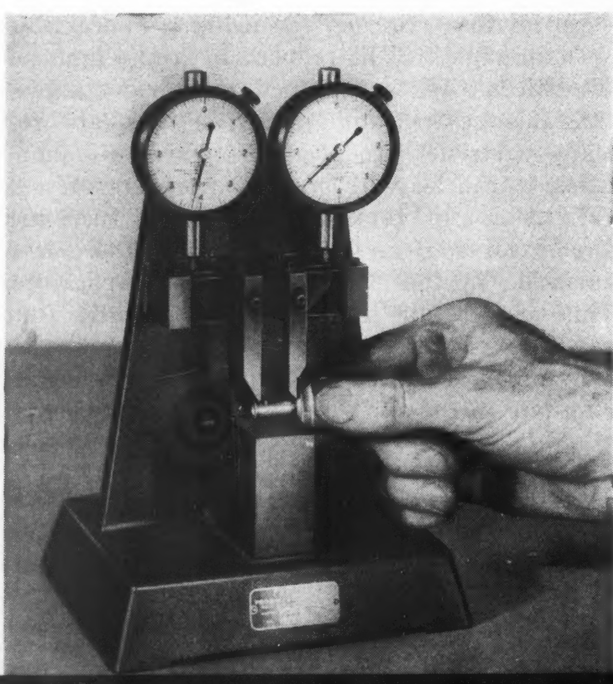


Fig. 2. Two diameters on a part are measured simultaneously by means of this special dial indicator fixture. Inspection time is reduced by about one-third, compared with hand checking

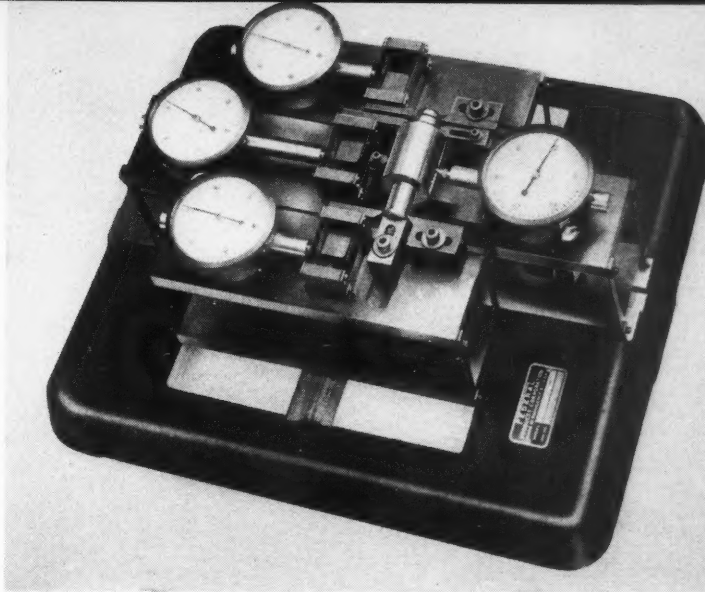


Fig. 3. Special indicator gage in which several parallel link-motion transfer units, or pantographs, are used to transmit size variations to the indicators, thus eliminating errors due to operator "feel"

operated trap door for disposal, which will replace the manual operation of putting the part into the box.

In this instance, the gage may be designed so that the operator pushes the part through, either by a hand-operated slide or by pushing one part into the gage after the other. After the measurement has been taken, the piece drops down a chute. The chute is provided with one or more solenoid-operated trap doors. As the part passes through the gage and the appropriate light flashes, the correct trap door opens, ready to receive the part. The part goes out the proper disposal trap and directly into the tote box without further handling by the operator. With this arrangement, the operator has no responsibility for either the measurement or the disposal of the part.

An example of this type of gage is shown in Fig. 5. The particular gage illlustrated is designed for checking the diameter of spark-plug insulators. The part is passed through the gage manually and drops into an aperture in back of the anvil, where it slides down a rubber-lined disposal chute. On a similar gage, the part is simply placed on a mandrel. Movement of a handle in one direction brings the part into the measuring position, after which the size is checked and the trap set automatically. Reversing the movement of the handle drops the measured piece down a disposal chute, and the gage is ready to repeat the cycle.

In many instances, it is possible to refine the gage further by making it a fully automatic machine requiring only the occasional loading of a hopper and the unloading of the receiving boxes. When a part is of such a nature that it can be hopper fed, it is only a matter of providing means for conveying the parts from the hopper to the inspection area. The gage shown in Fig. 6 is completely automatic, and is designed to check the four dimensions on the chain rivet shown in Fig. 1 at a minimum rate of 100 pieces per minute. An operator is required only for loading the hopper, unloading the boxes, and occasional set-up.

In cases where all parts go through a final operation in one machine, it is sometimes possible to eliminate even the loading of the automatic inspection machine by locating the inspection device immediately adjacent to the final processing machine. For example, a fully automatic gage designed to measure four thicknesses and the warpage of a plastic switch base was mounted adjacent to the exit side of the machine that performed the final thickness grinding.

The parts are fed through the grinder by a

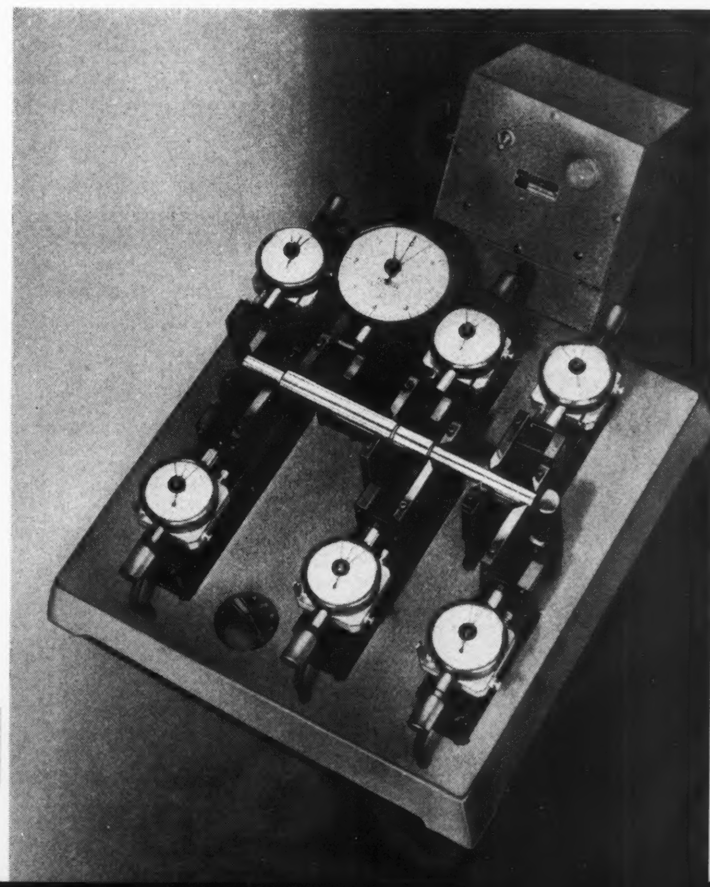


Fig. 4. Multiple-indicator gage equipped with automatic signaling device. If the signal light flashes red, part is over size; if amber, it is under size; and if green, part is within limits

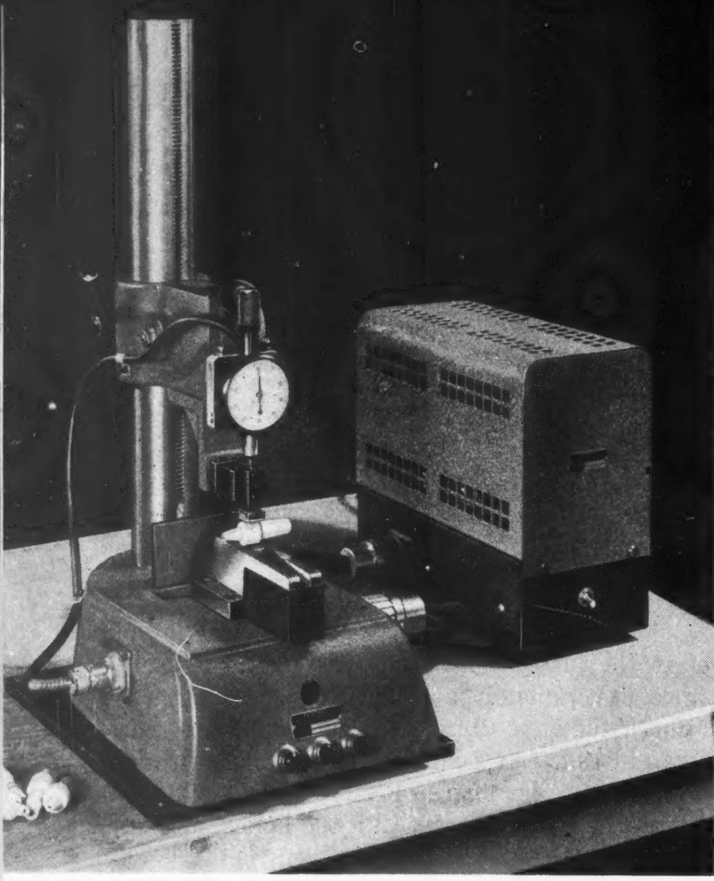


Fig. 5. Diameters of spark-plug insulators are checked and the parts automatically sorted by this gage. Parts pushed under the measuring anvil fall down a chute into the box of proper classification—over size, under size, or correct

chain drive, and the inspection machine receives these parts as they come from the grinder end to end, measures five characteristics on each part individually, and sorts them into under size, over size, or good classifications. Before the automatic gage was installed, operators had to take the plastic switch bases, make four separate thickness measurements on a comparator, and then rock the part on the flat comparator base to determine warpage.

In many instances, it is necessary or desirable to sort parts into a number of size categories. This is, in effect, taking the good parts and further subdividing them into a number of categories. Where it is necessary to sort parts in this manner, the measuring device must have a variable electrical output that is directly proportional to the size of the part. The variable electrical output is transmitted to a classifier, which interprets the signal as belonging to one particular classification of a number of groups and then operates auxiliary equipment associated with that group.

A simple device of this type is shown in Fig. 7. Here the operator is using an electronic gage to sort rollers for anti-friction bearings. As the part is passed beneath the gage spindle, a measurement is obtained and the voltage output proportional to the size of the part is transmitted to the classifier. The classifier, in turn, flashes a signal light and actuates a solenoid-operated trap door. With an arrangement of this kind, only one trap door opens at a time, and the part must be dropped through this particular door. While the classifier and trap-door assembly shown has only eight stations, classifiers can be built with as many as twenty categories.

An example of a more complex automatic gage of this type is shown in the heading illustration. This gage sorts fountain pen barrels into six diameter groups, in addition to over-size and under-size classifications. The unit shown is a fully automatic machine requiring only the loading of the hopper and the unloading of the disposal boxes. Measurement and sorting of the parts for selective assembly are performed at the

Fig. 6. Completely automatic hopper-fed gage that simultaneously checks the four dimensions shown on chain rivet, Fig. 1, at the rate of 100 pieces a minute

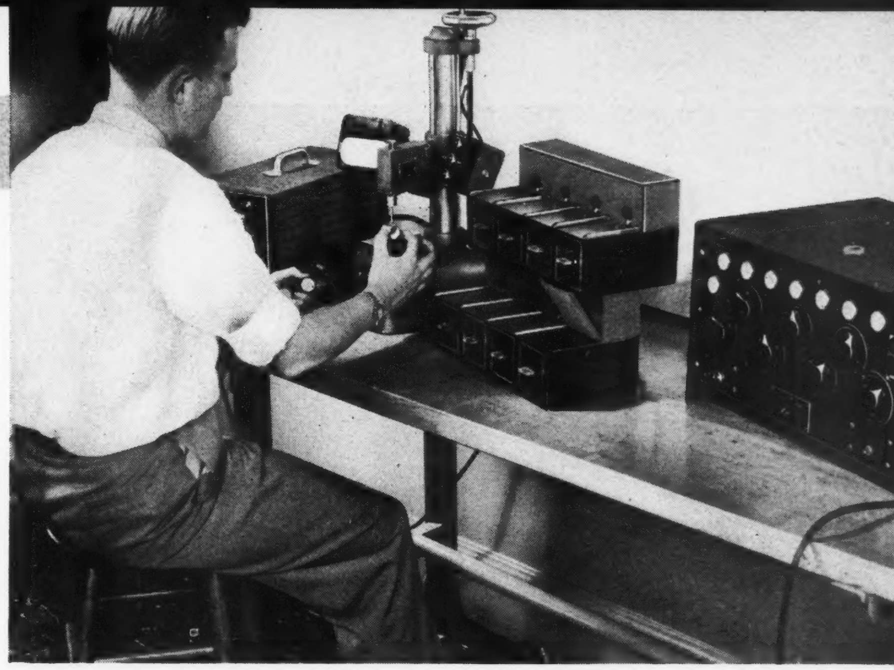


Fig. 7. Rollers for anti-friction bearings are sorted by this electronic gage. A variable electrical output, directly proportional to the size of the part, flashes one of eight signal lights and opens the corresponding trap door

rate of over ninety pieces per minute, and the possibility of human error is eliminated.

A similar gage is employed to measure and classify parts such as shown in Fig. 8, which would generally be considered difficult to handle in this manner. This gage measures the depth *A* on the small brass part. Owing to the fragility of the part and the accuracy required, it is not possible to use a hopper feed. The gage was therefore designed for magazine loading. The operator stacks a group of the parts into the magazine from which a feed-finger advances them onto an indexing rotary table which carries them around to the measuring station and, following the operation, to one of the disposal chutes at the rate of sixty pieces per minute.

After sliding down the disposal chute, the parts are stacked in the same manner in which they were received by the operator. Handling of the parts is therefore minimized, and instead of a series of operators checking the depth by means of hand gages, one operator can keep the magazine loaded and the chutes unloaded.

The savings effected by means of the gages described are considerable. For example, the initial price of a gage of the type shown in Fig. 6 is generally equal to the wages of between three and four operators for a period of one year. It is readily apparent that more than three or four operators would be needed for hand checking one million rivets per month—the output of this machine. Therefore, in direct labor savings alone this gage can be amortized over a period of from one to two years. This is in addition to the savings effected in assembly by eliminating spoilage due to improperly inspected rivets.

While all parts are not suited for automatic feeding methods, substantial savings can be obtained from gages that are hand loaded, magazine fed, or attached to the production machine. In general, when a hand-fed magazine must be used, the output is of necessity lower. The maximum speed generally feasible with hand feeding is approximately sixty pieces per minute. Beyond this speed, the operator cannot usually keep the machine loaded.

In most instances, there are advantages in using automatic measuring machines other than the financial saving. One such advantage is the improvement in quality of the product. When all considerations and comparisons have been made between hand and automatic gaging, the automatic gage generally proves to be the most economical means of rapid, accurate inspection.

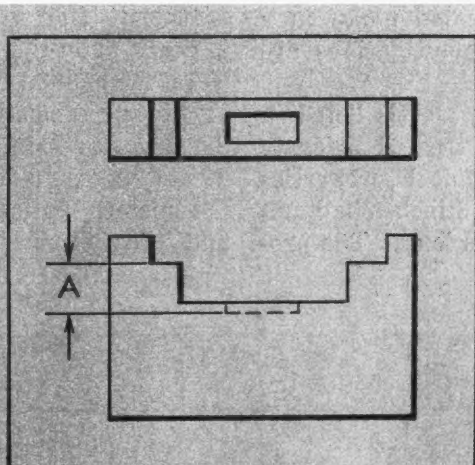


Fig. 8. Dimension (A) on the small brass part illustrated is measured and the parts are classified at the rate of sixty per minute on a completely automatic machine that is provided with a magazine feed

Tooling for Hot-Machining of Hard-to-Cut Metals

By HENRY JAMES
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A NEW concept in metal cutting involves heating the work to reduce the power required for machining. The shear strength and hardness of the metal are decreased as its temperature is increased, and consequently less power is required to shear the metal and plastically deform the chip being removed. This technique is considered to be particularly applicable to the cutting of stainless steels, high-temperature alloys, and other materials difficult to machine by conventional methods.

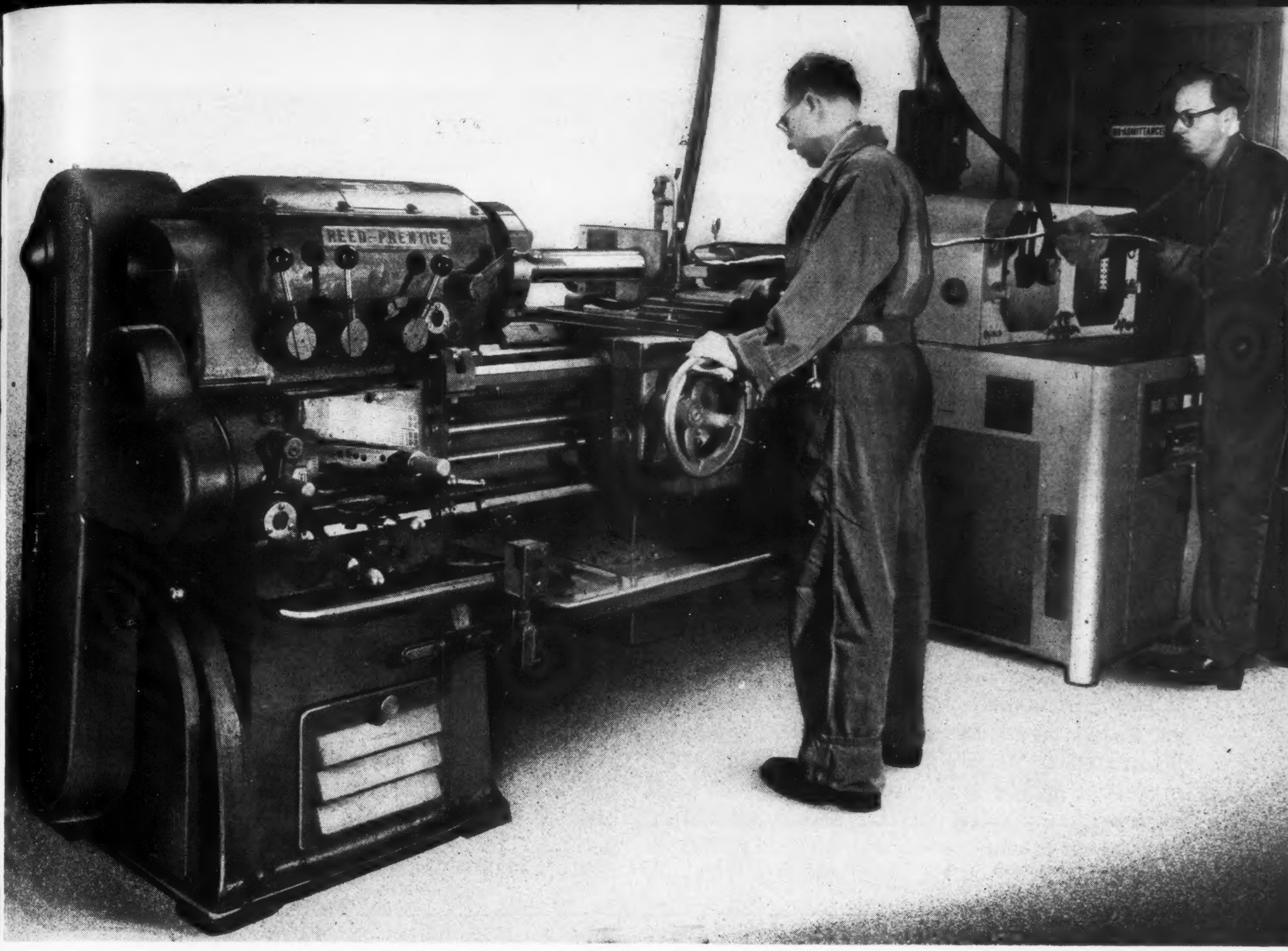
The heating of the work can be accomplished in different ways. Work-pieces that are still hot from previous operations, such as casting, forging, or rolling, can be machined before they cool. Cold parts can be preheated in a furnace or the work can be heated by gas flames or the electric induction process while mounted in the machine tool, immediately prior to machining. Attempts have been made to heat the metal by resistance heating, using the cutting tool as one electrode and a contact on the work as the other, but these were unsuccessful.

In 1947, a research and development contract was assigned to Sam Tour & Co., Inc., New York City, by the U. S. Navy Department, Bureau of Ships, to investigate and evaluate some of the factors involved in turning heated metal in a lathe. The results of these investigations are described in this article.

Tests were conducted on the metals listed in Table 1, which had been heat-treated prior to machining to obtain the physical properties shown. The test bars used were 3 inches in diameter by approximately 24 inches long. The procedure followed in testing the machinability at various temperatures was the same for each type of material. A series of runs was made in a lathe with the test bars at room temperature, employing various combinations of spindle speeds, tool feeds, and depths of cut. Then runs were made with the test bars heated to three different temperatures—500, 1000, and 1500 degrees F.—and the tool loads and stock removal rates were noted for comparable conditions.

In turning low-carbon, medium-carbon, chromium, and nickel steels by means of the hot-spot machining technique, stock removal rates may be improved three or four times, as compared with those possible at room temperature. A high-temperature, high-cobalt, low-iron alloy (Allegheny Ludlum Steel Corporation's S-816) has been turned with stock removal rates about one hundred times those usually recommended.

A Reed-Prentice 5-H.P. lathe of 14-inch capacity, shown in the heading illustration, was employed for the tests. To take care of longitudinal expansion of the work during heating, the lathe was equipped with a spring-loaded live tailstock. Provision was made to heat the work by the induction process or by gas flames. Power consumption was measured by timing the rotation of the disk of a watt-hour meter. The loads imposed upon the cutting tool during machining were determined by a specially developed dynamometer, consisting essentially of Baldwin-Southwark strain gages. Temperature measurements were made by means of contact type pyrometers, optical pyrometers, thermo-couples, and "Tempilstiks."



Carbide bits, held in insert type tool-holders, were employed as the cutting tools. If tools made of tool steel or high-speed steel were used, the temperatures reached at the tip of the tool in hot-spot machining would soften it, thus causing mechanical failure. In the case of carbide tools, however, a relatively high hardness is maintained up to temperatures of at least 1800 degrees F.

In turning carbon steels at temperatures from 1100 to 1500 degrees F., the chip formed as a continuous red-hot ribbon. Chip-breakers ground on the tool face had no effect. For production applications, some method of handling such a chip would have to be provided. Possible solutions would be to wind the chip on a reel, pass it through a guide tube to a power-operated chopper, or employ a rotary cutter, as described subsequently. In hot-machining S-816 high-temperature alloy, the chips were relatively short, ranging from 1/2 inch to 2 1/2 inches long.

Cimcool coolant (in the ratio of one pint of concentrate to four gallons of water) was applied to the shank, rather than the tip of the cutting tool, and also to the tailstock center. With this set-up, little heat seemed to be transferred to the lathe.

In heating the work with oxy-acetylene flames, a curved-stem torch made by The Linde Air Products Co. was connected to a seven-tip, water-cooled flame head and a gas-mixer, as seen in Fig. 1. Flame tips, 0.07 inch in diameter, were arranged in two rows, one row containing four and the other three. Since a narrow heat zone was found to be most desirable, the three-tip row was plugged. The gas-torch holding fixture was bolted to the lathe carriage, so that the flame tips traveled with the cutting tool.

A slightly oxidizing flame with about 5 per cent excess oxygen was found to be most suitable. The torch was set so that the ends of the inner cones were 3/16 inch from the surface of the test bar. Best results were obtained when the flame was applied perpendicular to the work. Acetylene pressure was maintained at 5 pounds per square inch, and oxygen at 10 pounds per square inch.

In heating the part by the induction process, a double "pancake type" coil was employed to concentrate the magnetic field generated in a

Table 1. Metals Cut in Hot-Spot Machining Experiments

Material		Approximate Chemical Composition (Average), Per Cent										Brinell Hardness	Tensile Strength, Pounds per Square Inch
Name	Specification	Carbon	Manganese	Silicon	Chromium	Nickel	Molybdenum	Cobalt	Tungsten	Columbium	Iron		
Low-Carbon Steel	AISI C1023	0.23	0.50	0.09	.....	.....	....	.....	....	....	Bal.	121	63,000
Medium-Carbon Steel	......	0.40	0.60	0.20	.....	0.25	....	.....	....	....	Bal.	192	85,000
High-Carbon Steel	Navy 49S2 Grade AN	0.70	0.43	0.20	0.93	1.64	....	.....	....	....	Bal.	192	93,000
Nickel Steel	Navy 46S4 Grade V	0.41	0.81	0.25	0.20	3.39	0.06	.....	....	....	Bal.	260	120,000
High-Temp. Alloy	Allegheny Ludlum S-816	0.34	1.43	0.23	19.50	19.74	4.17	42.15	4.30	3.05	2.65	286	160,000

narrow band on the work. The coil is mounted between asbestos boards 3/32 inch thick (Fig. 2), which prevents the chip coming in contact with the coil, thus causing arcing. The holes in the boards for the work are smaller in diameter than the coil to minimize arcing between the work and coil. The coil supporting fixture is bolted to the lathe carriage, but not attached to the cross-slide, so that the tool can be fed into the work without changing the clearance between the coil and the work. Work speed and tool feed are limited by the rate of carriage travel at which the coil can heat the bar.

A coil having an inside diameter of 3 1/4 inches, made from eight turns of 3/16-inch flat copper tubing, was employed with an Ecco 20-

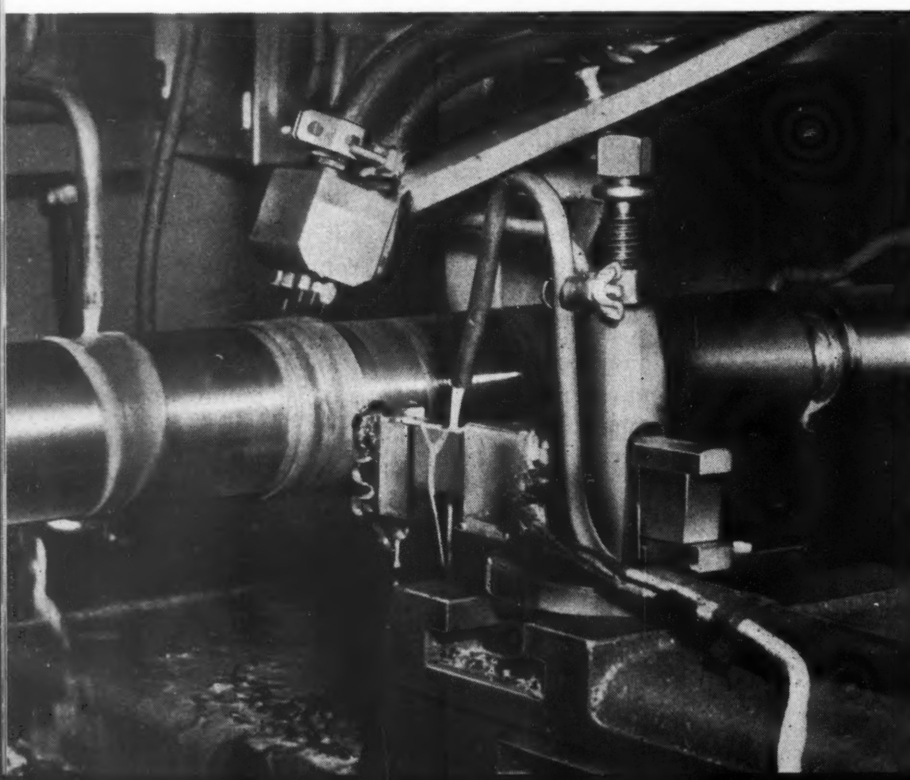


Fig. 1. A gas-torch holding fixture is mounted on the lathe carriage to heat the work by means of oxy-acetylene flames and thus facilitate machining

Fig. 2. Close-up view of the induction method of heating the work for hot-machining experiments. Note the continuous chip formed in hot-turning carbon steel

KVA induction heating unit having a frequency in the range of 300,000 cycles. With this setup, a band from 1/4 to 1/2 inch wide on a bar 3 inches in diameter can be heated to 1500 degrees F. in approximately six seconds. When the coil was traversed at the rate of 0.010 inch per revolution, with the work rotating at 73 R.P.M., surface heat on the bar was maintained at 1500 degrees F. minimum for a distance of 5 inches, even though full power of the heating unit was not applied. Depending upon the amount of power supplied by the induction heating unit, depth of cut, speed of work, and feed of tool and coil, the metal at the base of the cut may be at a barely visible heat (about 1100 degrees F.) when the outer surface is 1500 degrees F.

Heaviest arcing, when it occurred, was between the coil and the work. Arcing between tool and work was relatively light and infrequent, but some slight pitting of the tool was caused. Arcing between the chip and the lathe was very light. If arcing proves objectionable, a light copper brush could be attached under the tool to ground the tool to the work. Later runs proved that, by proper grounding of equipment, arcing could be practically eliminated.

Some difficulty was experienced in heating the S-816 high-temperature alloy. Test bars made from this material would only absorb about one-fourth the power output of the high-frequency induction heating unit. Improvement in the heating rate and maintenance of a more uniform heated zone were obtained with this material by using a lower frequency (10,000-cycle), 30-KW, motor-generator type of induction heating unit made by the Ohio Crankshaft Co. With this unit, a step-down transformer and suitable condensers were mounted on the rear of the lathe carriage. It was then possible to use a single-turn, low-voltage coil.

Induction heating, although more expensive initially, is considered to be more practical than gas-flame heating for hot-spot machining because the temperature of the metal can be more closely

Table 2. Comparative Results of Some Hot-Machining Tests

Material Tested	Cutting Temperatures, Degrees F.	Spindle Speed, R.P.M.	Feed, Inch per Revolution	Depth of Cut, Inch	Metal Removed, Cubic Inches per Minute	Metal Removed, Cu. In. a Minute per H.P. Input
Low-Carbon Steel	Room	73	0.010	0.019	0.128	*
	1500	73	0.010	0.064	0.423	*
Medium-Carbon Steel	Room	73	0.010	0.016	0.105	*
	1650	73	0.010	0.0645	0.415	*
High-Carbon Steel	Room	73	0.010	0.025	0.169	*
	1575	73	0.010	0.067	0.447	*
Nickel Steel	Room	136	0.024	0.125	3.85	0.75
	1500	136	0.023	0.250	7.36	1.47
S-816 Alloy	Room	91	0.015	0.0625	0.80	0.28
	1500	171	0.015	0.187	4.52	0.87

*Readings taken under conditions of equal torque, as measured by tool dynamometer.

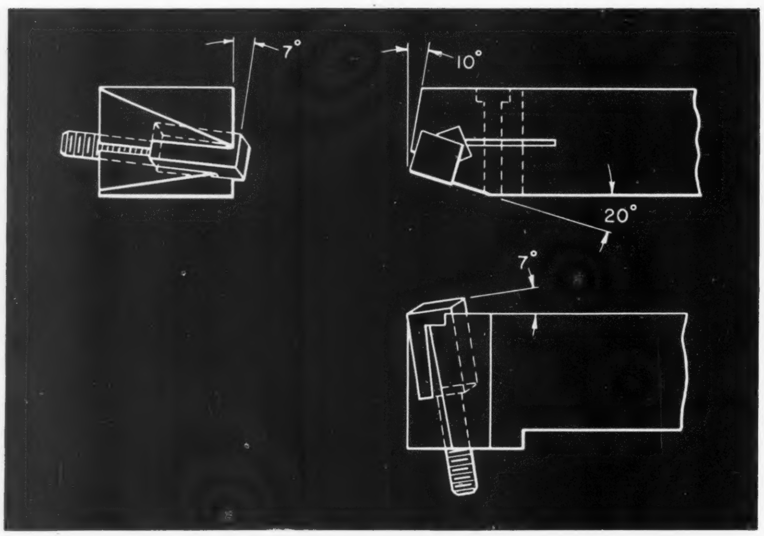


Fig. 3. Typical 3/8-inch square carbide tool bit and holder employed in making hot-spot machining tests

controlled, faster heating is possible, and, in general, operational costs are less. Other disadvantages of gas-flame heating are flame splash, intensity of light from the flame, and excessive heating of both tool and machine.

For each hot-machining test, a comparable cut was made without applying heat to the work. Thus a basis for comparison of the metal removal rates with each method was obtained. The ratio of metal removed when heat was applied to the work and when cut cold was about 4 to 1 for medium-carbon steel, 3 1/3 to 1 for low-carbon steel, 2 2/3 to 1 for Grade AN alloy steel, and 2 to 1 for Grade V nickel steel.

The results obtained in hot-machining S-816 alloy are considered outstanding. Heating test bars of this material to 1500 degrees F., 4.5 cubic inches of stock was removed per minute on the 5-H.P. lathe, with no noticeable tool wear and excellent surface finish. Recommended optimum metal removal rate for cold-turning of this alloy is 2.1 cubic inches per hour.

In all cases, tool loads decreased rapidly as the surface temperature of the metal increased. A comparison between metal removal rates obtained at room and elevated temperatures in some of the tests are given in Table 2.

Experiments were conducted to determine the effect of varying the rake angles on the cutting tool in machining Grade V nickel-steel bars. For these tests, temperature on the surface of the bars was maintained at 1000 degrees F., and

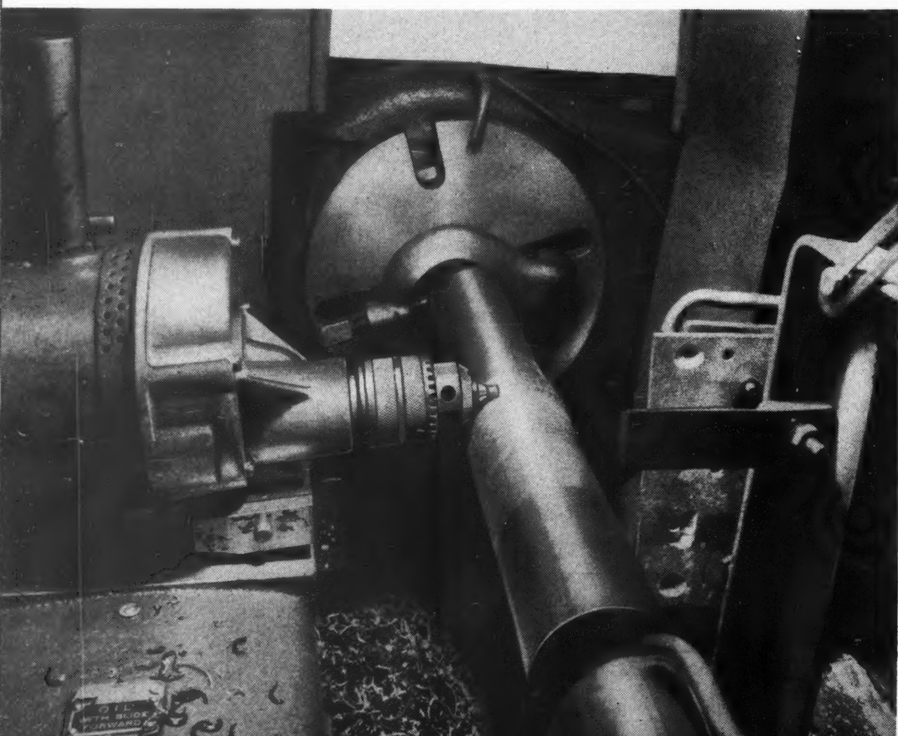


Fig. 4. Making a test with a cylindrical carbide tool bit held in the chuck of an electric drill, which is secured to the compound rest on the lathe carriage

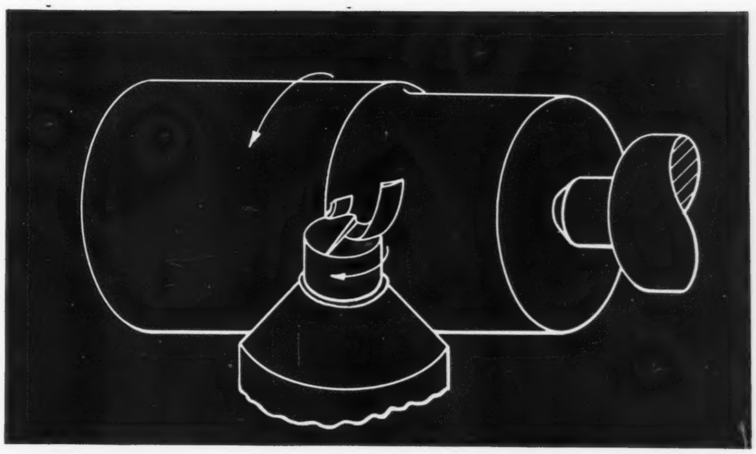


Fig. 5. Preferred design of rotary cutter for distributing wear and breaking up the chip during hot-turning

temperature of the chips was about 1325 degrees F.; work speed was 136 R.P.M., tool feed 0.024 inch per revolution, and depth of cut 1/4 inch.

A series of tests was made with the back rake angle held constant at 7 degrees negative while varying the side rake angle from 7 degrees negative to 7 degrees positive. Under these conditions, the horsepower input to the lathe was decreased from 6.45 to 6.08. When the side rake angle was held constant at 7 degrees negative while the back rake angle was varied from 7 degrees negative to 7 degrees positive, the horsepower input increased from 6.45 to 6.85. The most efficient tool tested had a negative back-rake angle of 7 degrees, a negative side rake angle of 7 degrees, end relief and side relief angles of 9 degrees, end cutting-edge angle of 20 degrees, side cutting-edge angle of 20 degrees, and a nose radius of 1/16 inch. A representative tool, Kennametal Style 115K, is shown in Fig. 3.

Most of the machining tests were made with 3/8-inch square, inserted type carbide tool bits, Carboloy Grade 78B and Kennametal K3H, but there is no assurance that these are the most suitable cutting tools. Throughout the tests, no difficulty was encountered from tool wear, breakage, or chatter. About 13 cubic inches of S-816 high-temperature alloy was removed with no evidence of tool failure.

Experiments were conducted with a rotary cutter, the object being to distribute the wear over a circular cutting edge, which could be kept rotating, and to shape or step the profile of the cutting edge so as to cut or transversely shear the chip being removed in turning. The set-up employed, shown in Fig. 4, consisted of a cylindrical carbide bit held in the chuck of a 1/2-H.P. electric drill. The cutter was rotated at 325 R.P.M., and could be adjusted to vary the depth of cut and clearance angle. Satisfactory tool wear and breaking up of the chip were obtained, but a rather poor surface finish was produced, mainly due to the lack of set-up rigidity.

The design of a rotary cutter considered preferable for these conditions is shown in Fig. 5, where vertical mounting of the tool-holder and spindle places the tool in its normal cutting position. However, considerable redesign of the lathe would be required to incorporate the proper mounting and drive for this design, and it was never tried.

The effects of hot-spot machining on hardness and microstructure are, in general, confined to very shallow depths below the machined surface. The depth of work-hardening below the machined surface was no greater than 0.02 inch. Maximum hardness was found when the bar was machined at room temperature. Maximum hardness and the difference between maximum hardness at or near the surface of the bar and core hardness decrease as the temperature of machining increases. Surface finishes produced in hot-spot machining were as good as or better than those obtained by turning at room temperature.

With further research and refinements, the hot-spot machining technique should prove of definite value in machining alloys for jet engine, gas turbine, and atomic energy applications. A possible extension of the technique—not investigated—would be to use the induction coil for reheating the work after machining, followed by a quench, to harden the metal.

Latest Press-Shop Methods Produce Latest Torque Converters

Hydraulic Torque Converters for the "Powerglide" Automatic Transmissions are Made from Precision Stampings Spot-Welded and Copper-Brazed to Pressed-Metal Housings. Outstanding Tooling and Techniques Employed in This Unique Production Set-Up are Described in This Article

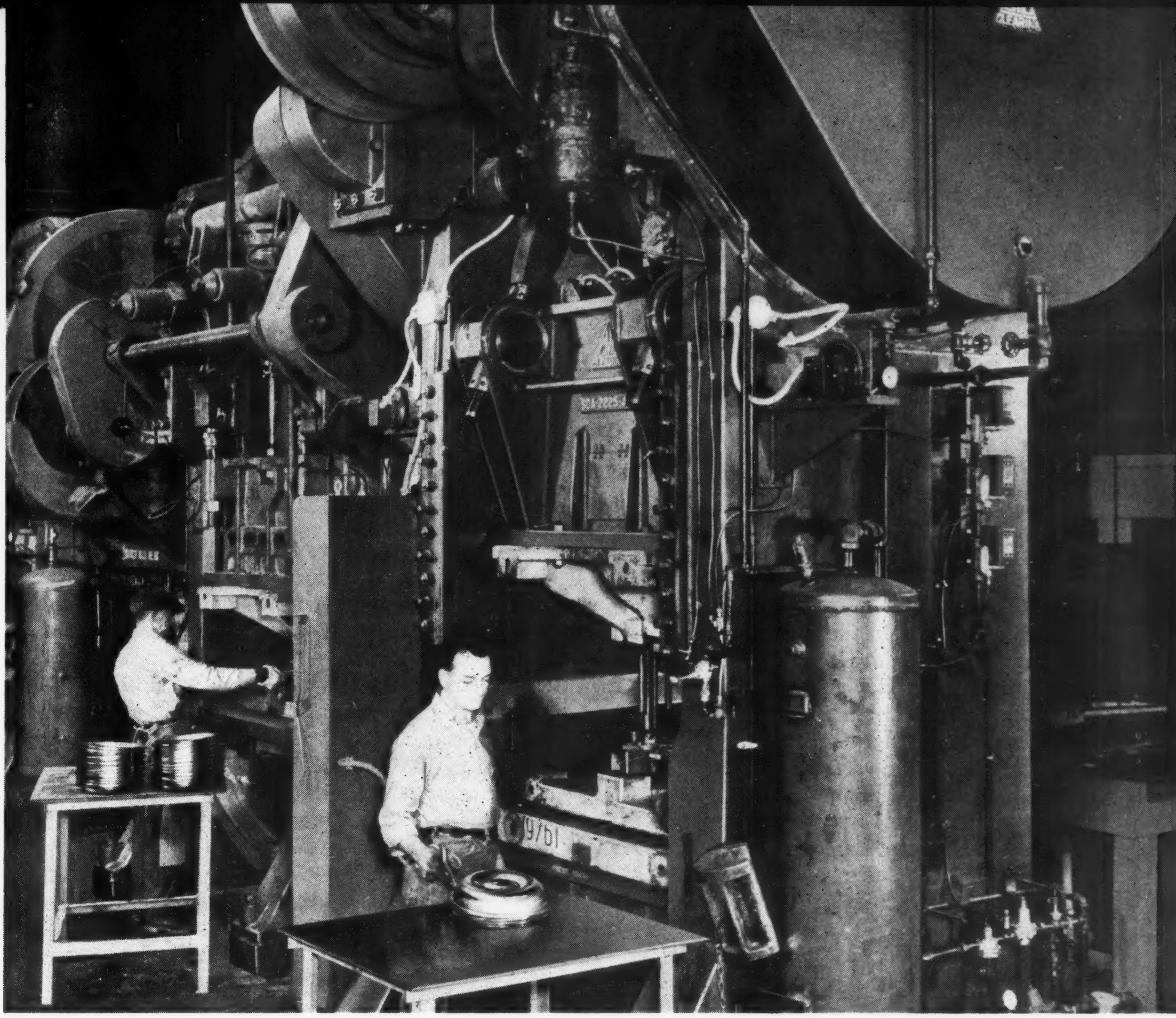
By CHARLES H. WICK

HYDRAULIC torque converters for automatic transmissions used in automobiles have been made heretofore of precision castings that require accurate machining to fit into mating forged or cast housings. An outstanding change in this design has been effected in the Chevrolet recently announced "Powerglide" transmission, the first automatic shifting device in the low-priced automotive field. The hydraulic torque converter for this automatic transmission is made from precision stampings, spot-welded and copper-brazed to pressed-metal housings.

During the development period, design engineers worked closely with tool engineers and manufacturing executives to evolve an efficient transmission that could be manufactured on a mass production basis in the most economical manner. The decision to employ a hydraulic torque converter of pressed-metal design introduced numerous manufacturing problems. The production techniques and tooling developed at the Chevrolet-Flint Manufacturing Division of the General Motors Corporation, Flint, Mich., for making this type of converter are described in this article.

The hydraulic torque converter, an exploded view of which is seen in Fig. 1, consists of five major components—the turbine, secondary stator, primary stator, secondary pump, and primary pump. Each component is a vaned wheel made from a number of steel stampings that are spot-welded and copper-brazed to form a subassembly. Adjoining wheels are made with slightly different numbers of vanes to avoid resonant vibration, and the two main components (the turbine and primary pump) are equipped with an extra set of vanes which forms the over-run coupling. The over-run coupling provides a braking action when the driver's foot is raised from the accelerator, permitting a stalled automobile to be started by pushing.

Accurate stamping and high quality welding and brazing are essential to minimize subsequent machining and provide an efficient torque converter. The unit must be oil-tight and able to withstand severe operating conditions, including pressures up to 200 pounds per square inch and temperatures of 140 degrees F. The primary pump and heavy pressed-metal torque converter housing must be dynamically balanced as an assembly within 1/4 ounce-inch. More than 120 major dies (including ten of the progressive type), 100 assembly and 200 inspection fixtures, and 127 major pieces of production equipment (including twenty-nine welding machines and three controlled-atmosphere furnaces) have been specially designed and built to manufacture the



hydraulic torque converters to unusually close limits of accuracy.

Each component of the hydraulic torque converter is equipped with its own specially designed vanes. The intricate shape and compound angles of these vanes present difficulties in forming, but progressive dies have been developed that accurately reproduce the forms at high production rates. All the vanes are stamped from deep-drawing, cold-rolled steel strip stock (AISI C-1008 or C-1010 steel, either 0.0239 or 0.0299 inch thick). Standard commercial stock having a thickness tolerance of ± 0.0035 inch cannot be employed because of the accuracy required, and the material is purchased to special specification having a thickness tolerance of only ±0.001 inch.

Vanes for the secondary stator are formed in a sixteen-station progressive die. Two vanes are completed at each stroke of the press ram, giving a production of 3000 pieces per hour. The die is mounted on a Danly 100-ton, high-speed press (Fig. 2) equipped with a Littell coil stock cradle and roll feed which advances the 5 1/2-inch wide strip 2 inches per stroke. A strip produced in this die is shown in Fig. 3, with the completed secondary stator vanes visible at the left.

Operations performed at consecutive stations in the die, from right to left, are lance and form, pierce, notch, pre-form, idle, finish-form, idle, trim sides, idle, trim ends, idle, restrike sides, idle, restrike, idle, and cut apart. Cam-actuated, side-acting slides are employed in the die for restriking and trimming operations. Idle stations are required between most of the active stations to provide the space necessary for the forming, restriking, and trimming steels. No tolerances are specified on the vane drawing, and the die is made as close as possible to the desired part dimensions. Most of the critical die dimensions have a tolerance of ± 0.0005 inch. The bottom

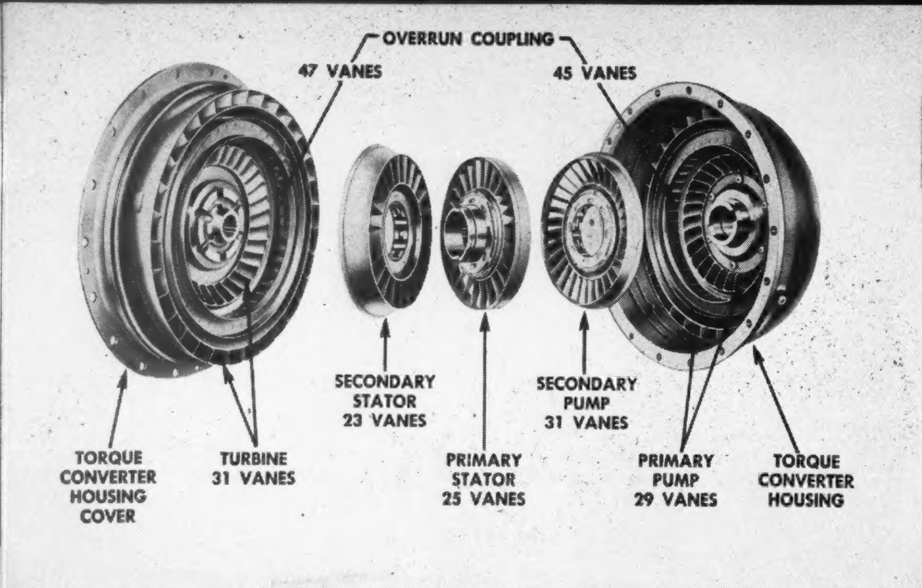


Fig. 1. Hydraulic torque converter for the Powerglide automatic transmission, which consists principally of a turbine, primary and secondary stators, primary and secondary pumps, and over-run couplings

half of a similar progressive die, which is used to form primary stator vanes at the rate of 3000 per hour, is shown in Fig. 4. A stock strip formed in this die is seen in the diemaker's hands.

Stamped vanes are burred by wet abrasive tumbling, after which they are washed and then bright annealed to eliminate the strains set up during cold-forming. A Lindberg roller-hearth, Globar type, controlled-atmosphere furnace is employed for annealing. Radiant heat is supplied to the parts by passing electric current through silicon-carbide bars made by the Carborundum Co. The furnace, which is 120 feet long, has a rating of 630 kilowatts, and handles a load of 2080 pounds of stampings per hour.

An endothermic gas generator supplies the furnace with a controlled atmosphere containing from 38 to 40 per cent hydrogen. In the first 30 feet of the furnace, the parts pass through four zones, which heat the work progressively to a temperature of 2050 degrees F. While passing through the remaining 90 feet, the vanes are slowly cooled to approximately room temperature. About one hour and ten minutes is required for the complete heating and cooling cycle.

Annealed vanes are oiled and then restruck on a 60-ton Minster press, as shown in Fig. 5, to insure that the parts will be of the desired finished dimensions. This press is equipped with an eight-station rotary indexing table. Each station is provided with a plastic work-carrier made from a plaster cast of the stamping die, on which one vane is placed. The vanes are automatically transferred from the work-carriers to the restrike die by a "Feed-O-Matic" vacuum pick-up mechanism (seen at the center) made by the Covert Mfg. Co. Vacuum pick-up is satisfactory for the smaller vanes, but on the larger stampings, there is some distortion due to annealing, and some of the mechanisms have been converted to electrically energized magnetic types in order to insure positive pick-up and transfer of the stamping.

A unique arrangement is employed on these

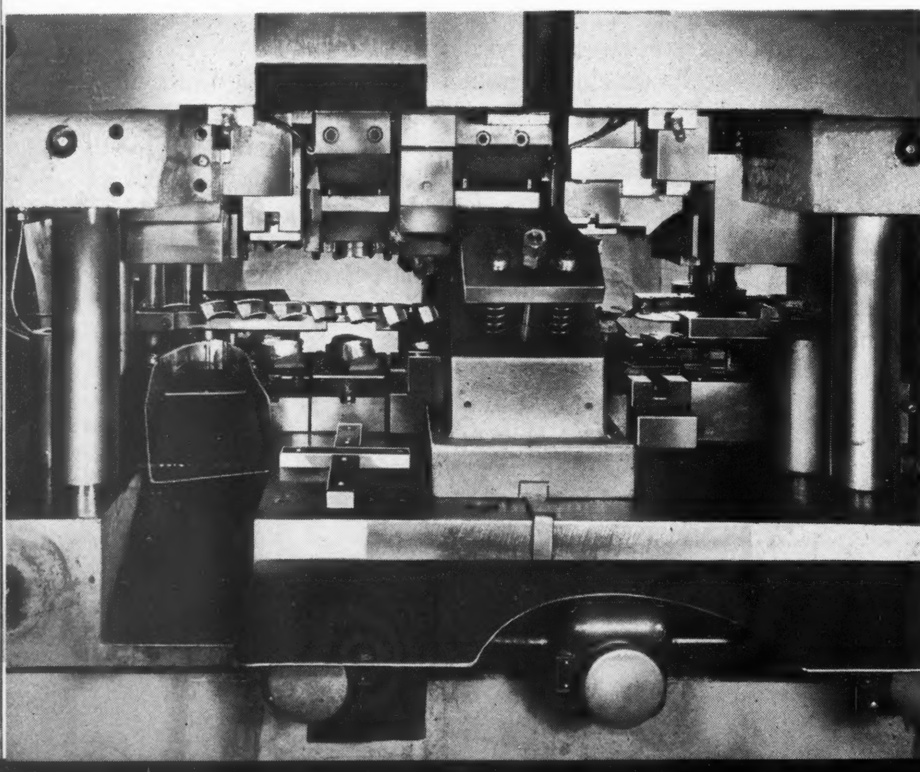


Fig. 2. Sixteen-station progressive die used to form secondary stator vanes, two per stroke, at the rate of 3000 per hour. Cam-actuated, side-acting slides restrike and trim the vanes

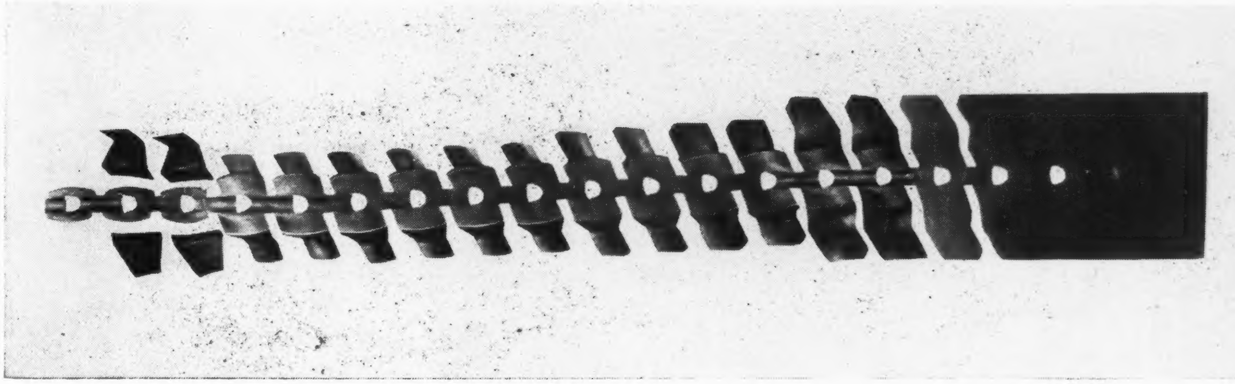


Fig. 3. Stock strip produced in the sixteen-station progressive die shown in Fig. 2. Completed secondary stator vanes are illustrated at the left

presses to insure that only one vane is restruck at a time. The restruck vane is ejected from the die automatically by a blast of compressed air, the part being blown out the back of the press, down a chute, and into a tote pan. A fine copper-wire, light-weight screen is suspended across the lower part of the chute, and is electrically interlocked with a solenoid that controls the operation of the press. Air-blown vanes being ejected from the die swing the wire gate upward, thus permitting the restriking cycle to be repeated. When a vane sticks to the punch or die and is not ejected, the press ram cannot be lowered until the trouble is corrected.

After inspection, stator and over-run couplings are ready to be spot-welded and copper-brazed to their respective pressed-metal shells. These assembly operations will be described subsequently. Flanged brazing edges of the pump and turbine vanes are liquid-honed prior to assembly by subjecting them to blasts of abrasive suspended in water. Liquid honing produces a matte finish, which improves the capillary action and permits the copper to adhere more readily to the honed surfaces during brazing.

Liquid honing is accomplished in a special machine, Fig. 6, made by the Vapor Blast Mfg. Co. Each vane is placed in one of the hinged rubber clam-shell fixtures mounted on the two endless chain conveyors provided on the machine. After the upper half of the fixture is lowered, only the flanged brazing edges of the vane are exposed to the abrasive as the fixture is carried through the blasting cabinet. The honed vanes automatically fall from the fixtures at the rear of the machine, and the empty fixtures are returned to the loading stations by the conveyors. A production of 7200 vanes per hour is obtained in this operation.

A finely powdered, non-toxic siliceous rock, called "Novaculite," which is made from Arkansas Novacite stone, is employed as the abrasive for liquid honing. The 140-mesh abrasive is suspended in water in the ratio of 60 per cent abrasive to 40 per cent water. A small amount of a

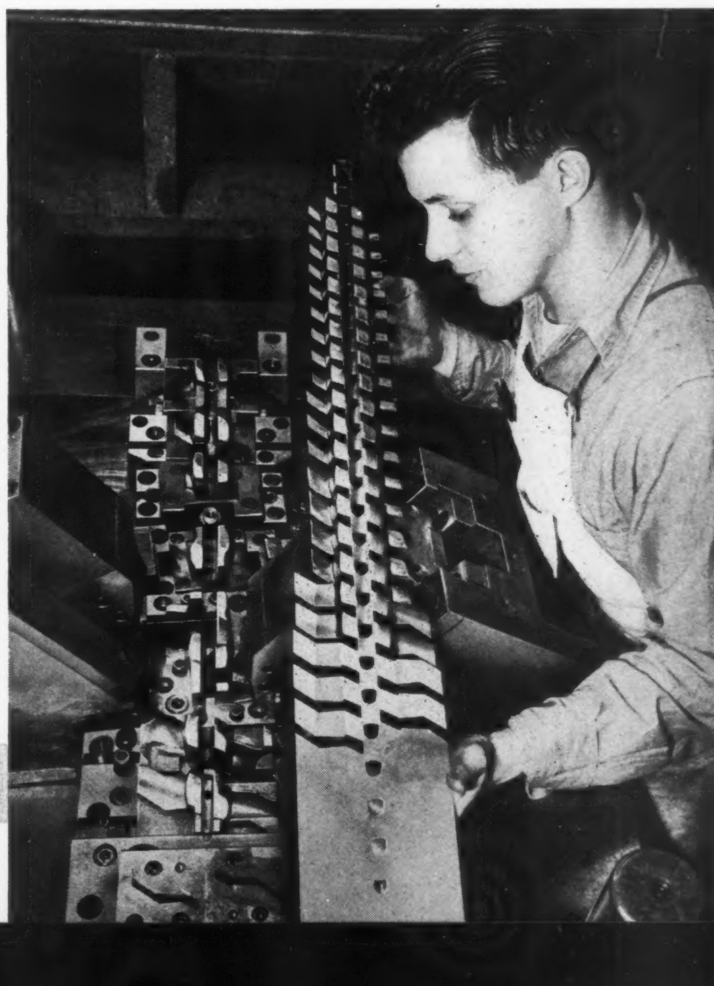


Fig. 4. Progressive die used to form primary stator vanes from strip stock

Fig. 5. Vanes placed singly in plastic molds mounted on a rotary indexing table are automatically transferred to the restrike die by means of a vacuum pick-up mechanism

wetting and dispersing agent is added to the solution to prevent the abrasive from settling out or solidifying. A rust-preventive chemical is also used, and the vanes are oiled after honing.

Two shells are required for each of the five torque converter elements, and two pairs of shells for the two over-run couplings. These shells, or containers, in which the vanes are mounted are produced by blanking and drawing to within 3/16 inch of the desired depth, inspecting the drawn depth, washing, bright annealing to remove the cold-working stresses, oiling, finish-drawing to depth, finish-piercing the center hole, trimming, and final inspection. As is the case with the vanes, stock is specially purchased to a thickness tolerance of $\pm$ 0.001 inch.

Inner shells for the turbine over-run coupling are blanked, drawn, and pierced from sheet stock 12 1/8 inches wide by 0.0239 inch thick on the Cleveland 90-ton press seen at the left in the heading illustration. Primary pump outer shells, which are 10 7/8 inches in diameter, are blanked, drawn, and pierced on the Clearing 225-ton double-action press seen at the right. The outer shells are formed from cold-rolled sheet steel, 13 1/4 inches wide by 0.0418 inch thick. In this operation, the press ram exerts a pressure of 135 tons, while the blank-holder develops 90 tons pressure.

Planet carriers, clutch flanges, and clutch hubs for the automatic transmission are formed from heavier gage stock in progressive dies mounted in a Danly 1000-ton mechanical press. The thirteen-station progressive die employed to form

Fig. 6. Flanged brazing edges of the primary pump vanes are liquid-honed to improve their capillary action and permit copper to adhere more readily to the surfaces during brazing

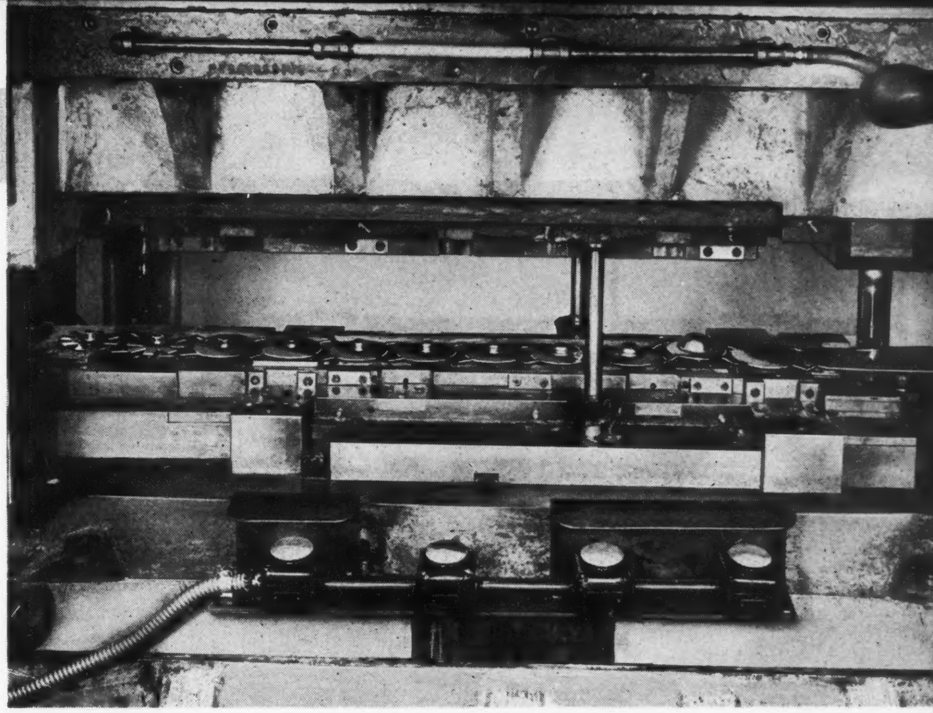


Fig. 7. Thirteen-station progressive die, mounted in a 1000-ton press, which forms clutch hubs from coil stock 6 1/8 inches wide by 0.1345 inch thick at the rate of 400 per hour

clutch hubs at the rate of 400 per hour can be seen in Fig. 7. A high degree of accuracy and close control of wall thickness are required in the production of this part. The clutch hub is formed from deep-drawing, cold-rolled coil stock, AISI C-1008 or C-1010 steel, 6 1/8 inches wide by 0.1345 inch thick $\pm$ 0.003 inch.

With the aid of a subsequent restriking or coining operation, the over-all height of the clutch hub is held to 0.697 $\pm$ 0.005 inch. The bore, which is subsequently splined, must be held to 0.893 $\pm$ 0.004 inch. Both the outside and inside peripheries of the eight flanges and the bottom surface of the clutch hub must be smooth and concentric or square with the bore within 0.005 inch total indicator reading.

The eight slots punched in the periphery of the blank to form the flanges must be equally spaced, and slot width is maintained, from top to bottom of the part, within $\pm$ 0.005 inch. Ordinarily, slots required in such thick stock would be milled after the part had been formed, but it was found that by careful die design, close tolerances could be held by slotting and flanging in the progressive dies. The outside diameter of the clutch hub is held to 3.688 $\pm$ 0.007 inch. The stock thickness in any section of the part does not exceed 0.1375 inch after stamping, which is only 0.003 inch more than the nominal thickness of the coil stock.

While the initial cost of such an intricate progressive die is high (approximately $30,000), the unit cost per part produced is low with existing high production. To produce such a part in twelve separate operations on different presses, each with its own operator, would be very costly. A special air pad and cushion is provided in the sub-bolster of the press bed on which the die is mounted. A progression, or stock advance per press stroke, of 6 3/8 inches is necessary to produce this part.

A stock strip produced on this progressive die and a completed clutch hub are illustrated in Fig. 8. Operations performed on the strip at

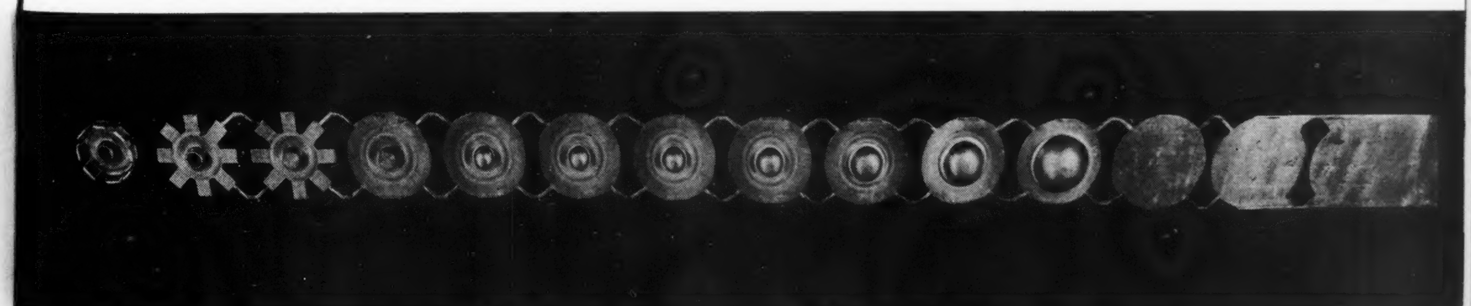


Fig. 8. Stock strip produced in the thirteen-station progressive die seen in Fig. 7. Completed clutch hub is shown at left

Fig. 9. Hydraulic torque converter housings are drawn from steel plate 0.1783 inch thick. After spot-welding a ring to under side of flange, the housing is accurately coined to size on a 2000-ton press

consecutive stations in the die, from right to left, are first and second notching, drawing, first to sixth sizing, restriking, notching of the eight slots, trimming of four connecting tabs and piercing of the central hole, and cutting off or separating and flanging.

The first drawing operation produces a 3.600-inch diameter dimple at the center of the part, which is progressively reduced to an 0.892-inch diameter, sharp-cornered, straight-sided hub in six successive stations. The wall of the hub offers sufficient resistance so that no lower die is necessary at the twelfth station, where a slug is punched from one end of the hub to form the bore of the part.

Housings for the hydraulic torque converter are formed from hot-rolled steel plates, AISI C-1008 or C-1010, 0.1783 inch thick. Plates are purchased with a thickness tolerance of ± 0.005 inch. The housings are blanked and drawn on a Clearing 600-ton double-action press. Thickness of the housing flange is increased by welding a ring to the under side of the flange. The ten spot-welds made in this joining operation are so positioned radially that they will not interfere with subsequent drilling and tapping of the flange.

The housings are then accurately restruck to size in a coining die on a Toledo 2000-ton, knuckle-joint press, Fig. 9. The inside diameter is held to 11.065 inches ± 0.005 inch, and concentric within ± 0.005 inch total indicator reading. Out-of-roundness of the outside diameter is maintained to 0.010 inch. The flange must be

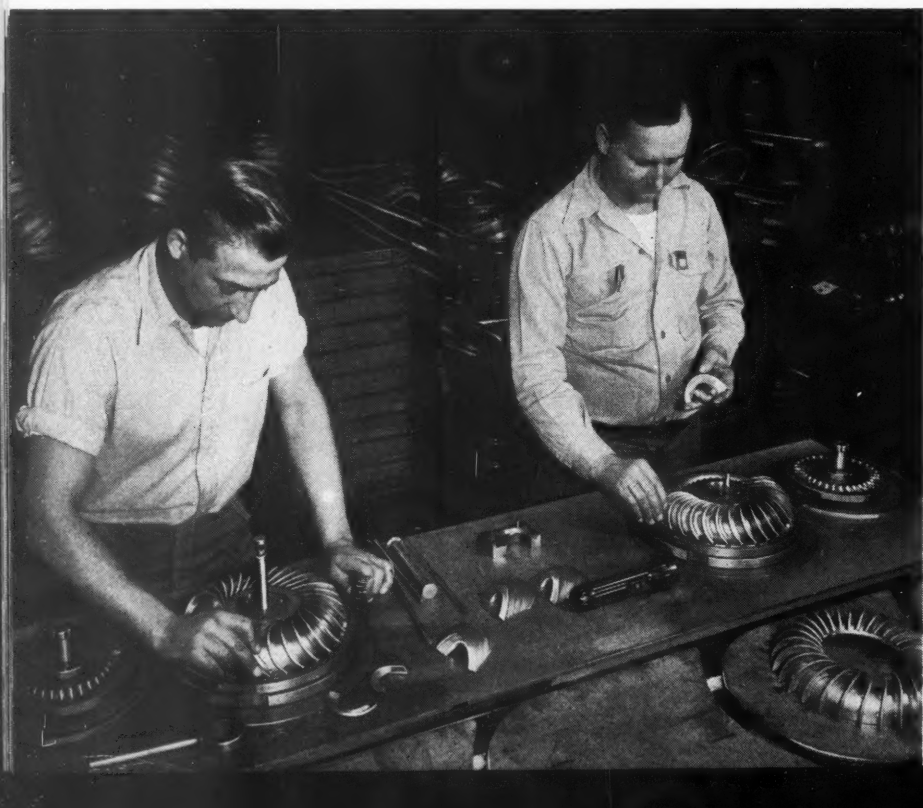


Fig. 10. Assembling the vanes on turbine inner shells in preparation for spot-welding. Ends of vanes fit into slots in fixtures. Perforated covers placed on top of the assembly permit the welding guns to contact the work

parallel to the dished, opposite end of the housing within 0.010 inch. Concavity and convexity of the dished end is held within 0.003 inch of the desired form.

Operators are seen placing vanes on the turbine inner shells in Fig. 10, preparatory to spot-welding. The fixtures are slotted radially at both top and bottom to receive the ends of the vanes. When a complete set of vanes has been positioned, the large plain rings shown at the left and right on the bench are placed over the fixture to retain the lower ends of the vanes in position. The perforated covers seen within these rings are then placed on top of the assembly fixture to retain the upper ends of the vanes. By rotating the handwheel on the cover plate slightly, a light pressure is exerted on the vanes through a cam action. Holes drilled angularly through the cover plate permit the electrodes to contact the vanes during spot-welding. A spot-welded vane-and-shell assembly for the primary pump is seen on the conveyor at the lower right.

Individual fixtures and twenty-nine specially designed welding machines are employed to join the various vanes to their respective components of the hydraulic torque converter. The fixtures must hold the vanes in accurate relation to each other and the shell during welding, with practically a zero clearance between the edge of the vane and the shell to insure proper fusion during subsequent brazing. Precision must be maintained by minimizing distortion of the relatively thin stampings due to the heat generated in welding. A major production problem was the development of strong electrodes that would be small enough to enter the compact fixtures and contact the closely spaced vanes. Small hydraulically actuated, pinch type welding guns had to be rocked into position to spot-weld vanes to the tiny stators.

A National four-post, hydraulically operated welding machine, Fig. 11, is employed for the second operation in joining vanes to the primary pump. The first operation consists of joining the central portions of the vanes to the inner shell, making one spot-weld on each vane. In the second operation, two spot-welds are made on each vane, one near the top and the other near the bottom.

The fixture holding the vanes and shell in position is placed on the copper table of the machine,

Fig. 11. Four-post, hydraulically operated welding machine employed to join vanes to primary pump inner shells. The part is indexed four times and two spot-welds are made on each of the twenty-nine vanes

Fig. 12. Set-up employed to assemble vanes automatically to the inner and outer shells of over-run couplings. Vanes are supplied from the rotating hopper seen at the upper right

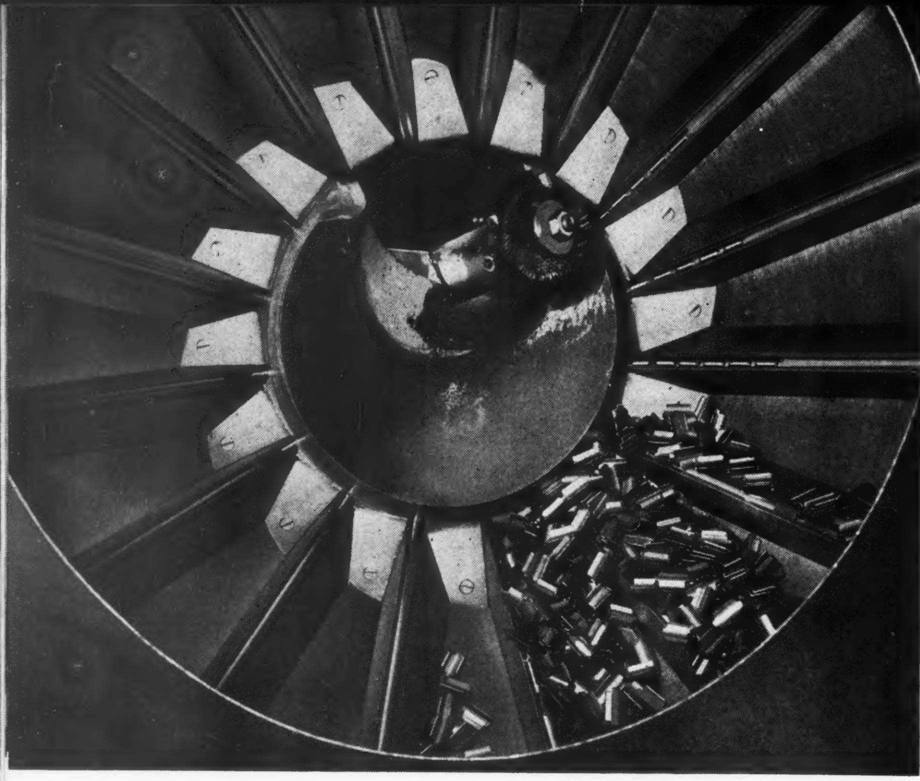


Fig. 13. Close-up view of the vane-feeding hopper used on automatic loading and staking machine seen in Fig. 12. The vanes are agitated by rotating hopper until they become aligned

as shown, and a push-button is depressed. This causes the table to be automatically pulled to the center of the machine by a hydraulic cylinder, and the twelve welding guns to be hydraulically advanced into contact with the vanes. Electrical current passes from the electrodes on the guns through the work in a series weld and back to the transformers. After a pre-set time interval, the guns are automatically retracted and the table is indexed. This cycle is repeated four more times to complete the spot-welding.

Since there are only twenty-nine vanes on the primary pump, two of the guns are automatically "shorted out" and made non-operative for the last series of welds. Each welding gun is provided with a separate 30-KVA transformer. A production of 130 per hour is obtained.

Vanes for the over-run couplings are assembled to their respective inner and outer shells by means of an automatic loading and staking machine, Fig. 12, made by Danly Machine Specialties, Inc. A five-station rotary indexing table, a unique hopper feeding mechanism, and two Minster 30-ton horn presses are included in the set-up. At the first station (lower left), an outer shell of the over-run coupling is placed on the fixture and a radially slotted vane locator is put on top of the shell. When the fixture has been moved to the second station (lower right), it is indexed to permit the automatic insertion of each vane, one at a time. The vanes are supplied from the rotating hopper seen at the upper right.

At the third station, a punch mounted on the horn of the first press contacts the top of the vanes and forces the vanes, vane locating ring, outer shell, and fixture downward against spring pressure, thus staking the bottom prongs on the vanes to the shell. When the fixture has been indexed to the fourth station, seen at the rear of the rotary table, a second operator removes the locating ring and places an inner shell over the upper prongs on the vanes.

At the fifth station, a punch mounted on the horn of the second press stakes the upper vane prongs to the shell. When the fixture returns to the first station, the completed over-run coupling is unloaded, another outer shell is placed on the fixture, and the cycle is repeated. A production of seventy-five couplings per hour is obtained in this vane loading and staking operation. Double, inner locked controls prevent the rotary table from being indexed unless the buttons are depressed simultaneously by both operators. Plexiglas guards are provided around both staking dies.

A close-up view of the vane-feeding hopper is illustrated in Fig. 13. The over-run coupling vanes are thrown into the hopper at random. As the hopper rotates in a counter-clockwise direction, the vertical ribs and downward slope of the troughs cause the vanes to be constantly agitated until they become properly aligned on the slides on top of each vertical rib. When a slide passes the rotating wire brush, a vane is pulled off into the gravity tube leading to the loading device. A cam-actuated plunger, timed to operate in conjunction with the fixture indexing mechanism, forces the vanes, one at a time, through the vane

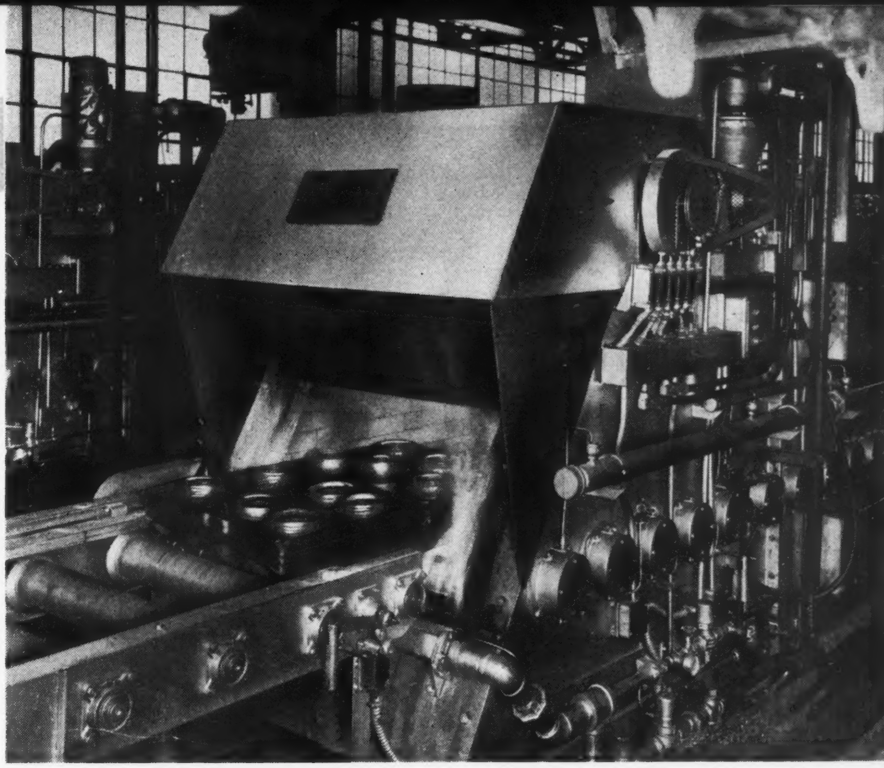


Fig. 14. Loading end of one of two controlled-atmosphere furnaces employed to copper-braze the five major components of the hydraulic torque converter. Each furnace is 212 feet long

locating ring into the outer shell of the over-run coupling.

Following the vane assembling operation, the over-run couplings are pressed with a "glove fit" into the turbine and primary pump sub-assemblies. Hub flanges are located in position and, in the case of the primary pump, a welding flange is pressed on the periphery of the sub-assembly. This flange is used later in welding the brazed sub-assembly to the torque converter housing. After careful inspection of the vane heights, run-out of the sub-assemblies, and other critical factors, the five major components are ready for the copper-brazing operation.

Copper grains, 500-mesh, are suspended in a propylene glycol vehicle in the ratio of five pounds of copper to one quart of glycol. The solution is applied to the sub-assemblies by dipping or spraying. Viscosity and temperature are carefully maintained, and the solution is constantly agitated to keep the copper in suspension. Parts are allowed to stand for a minimum of ten minutes, to allow excess fluid to drain off. This minimizes pick-up of carbon caused by burning of the propylene glycol in the brazing furnace. In addition to the application of the copper solution, copper wire rings are loosely placed on the turbine hub, the primary pump hub, and the outer flange of the primary pump.

The parts thus prepared are placed on carbon blocks projecting upward from nickel-chromium, heat-resistant alloy fixtures. Trays of loaded fixtures are introduced into either of two Lindberg roller-hearth, Globar type, controlled-atmosphere brazing furnaces, Fig. 14. These furnaces, which are believed to be the longest in the world, are 212 feet in length over all. Each is rated at 700 kilowatts and can handle 2280 pounds of parts per hour.

As is the case with the annealing furnace previously described, endothermic gas generators supply the furnaces with a controlled atmosphere containing from 38 to 40 per cent hydrogen. The temperature of the work is raised to 2050 degrees F. in about twenty minutes while passing through four heat zones that occupy the first 40 feet of each furnace. The parts are slowly cooled while passing through the remaining length of the furnace, and are cool enough to be picked up by hand at the discharge end. The entire heating and cooling cycle requires from fifty-five minutes to one hour and ten minutes, depending upon the load.

After the brazing operation, the primary pump sub-assembly is spot-welded inside the converter housing, the unit being joined to the welding flange in front and the hub flange at the rear. All elements of the hydraulic torque converter are then inspected for parallelism, out-of-roundness, depth and fusion of brazing, etc.

Sixteen Cams Cut at One Time on a Special Gear Shaper

A Special Fellows Gear Shaper is Employed by the Warner & Swasey Co. for the Multiple Cutting of a Variety of Hardened Steel Cams to Close Tolerances. The Rotary Speed of the Work is Varied Automatically during the Cutting Cycle by Cams and Electrical Controls

By CHARLES H. WICK

MORE than forty different sizes and shapes of cams for textile machines made by the Warner & Swasey Co. are accurately cut from hardened steel blanks on the special Fellows gear shaper shown in the heading illustration. The larger size cams, varying from about 6 to 7 3/4 inches in diameter, are machined sixteen at a time, while in the case of the smaller, thicker cams three or four are cut simultaneously. The contour at any point on the periphery is maintained within a tolerance of ± 0.001 inch of the specified distance from the center on the smaller cams and within ± 0.002 inch on the larger sizes.

The cams are made from S A E 4140 steel plates, pierced and blanked to the desired contour, with an allowance of about 1/32 inch of stock on the periphery for subsequent machining. Cam diameters range from 2 3/4 to 7 3/4 inches, while the thicknesses vary from 1/4 to 3/8 inch. Prior to machining, the blanks are heat-treated to a hardness of 30 to 34 Rockwell C. This procedure is necessary because distortion would result if the relatively thin parts were hardened after machining.

For the machining operation, the cam blanks are mounted on a vertical mandrel on the work-table of the shaper, as shown in Fig. 1, and are secured by means of a C-clamp and screw. A reciprocating, non-rotating cutter machines the periphery of the cams on its down stroke. The cutter is a plain disk of high-speed steel having relieved sides and a diameter equal to that of the roll-follower that will be used on the cam in the textile machine. Only three cams are shown being cut in the set-up illustrated, but, as previously mentioned, larger cams with less throw can be cut up to sixteen at a time, using larger diameter cutters.

The saddle which carries the reciprocating cutter is moved toward and away from the work by a master cam, seen at the left in Fig. 2. A roller mounted on a bar attached to the saddle is held in contact with the periphery of the master cam by weighted chains. A master cam 16 inches in diameter is required for each type of cam cut, and the contour of the master is the inverse of the shape to be cut on the cams. The work-table is cam-oscillated, automatically withdrawing the work from the tool on each up stroke.

The spindles on which the work and master cam are mounted rotate at the same speed. An outstanding feature of the gear shaper designed for this cam-cutting operation is the means provided for automatically changing the rotary speed during the cutting cycle. Different rotary speeds are necessitated by the irregular contour

of the work; a comparatively high speed can be used on dwell portions of the work, but a lower speed is required on steep rises. The rate of reciprocation (strokes per minute) of the non-rotating cutter is maintained constant during the cutting cycle, while the rotative speed of the work and master cam is varied to obtain a constant rotary feed of 0.012 to 0.014 inch per stroke over the entire periphery of the cam. On many of the cams cut on this machine, only one or two rotative speeds need be used, while cams having very irregular contours require as many as eight changes in speeds.

The work and master cam are rotated by a gear train driven by a 1/2-H.P., variable-speed motor provided with a General Electric Thymatrol for operation on alternating current. Eight control cams, which are pre-set to change the speed at various angles of work rotation, are mounted on the master cam spindle directly behind the master cam. The cams are interlocked with five rheostats, which are also pre-set to obtain the desired speeds.

In setting up the machine, the operator rotates the master cam until a line inscribed on its face coincides with the center line of the roll-follower contacting the master. A nut on one end of the master cam spindle is then released, and the control cams are pulled out of engagement. Next the graduated control cams are rotated and the rheostats adjusted to the setting given on a set-up chart for the particular cam to be cut. Then any one of the five rotative speeds corresponding to the rheostat readings can automatically be obtained at the various angles of work rotation set on the control cams. Each of the control cams can be set at intervals of 5 degrees of work rotation if necessary.

The machine is now ready to operate, and the cutter is fed to depth by moving the cutter-head. Approximately 0.026 inch of stock is removed from the periphery of the cams in the roughing cut, which is completed in one revolution of the work. When the roughing cut is finished, the machine automatically stops and the cutter is rotated a slight amount by hand to present a

SIXTEEN CAMS CUT AT

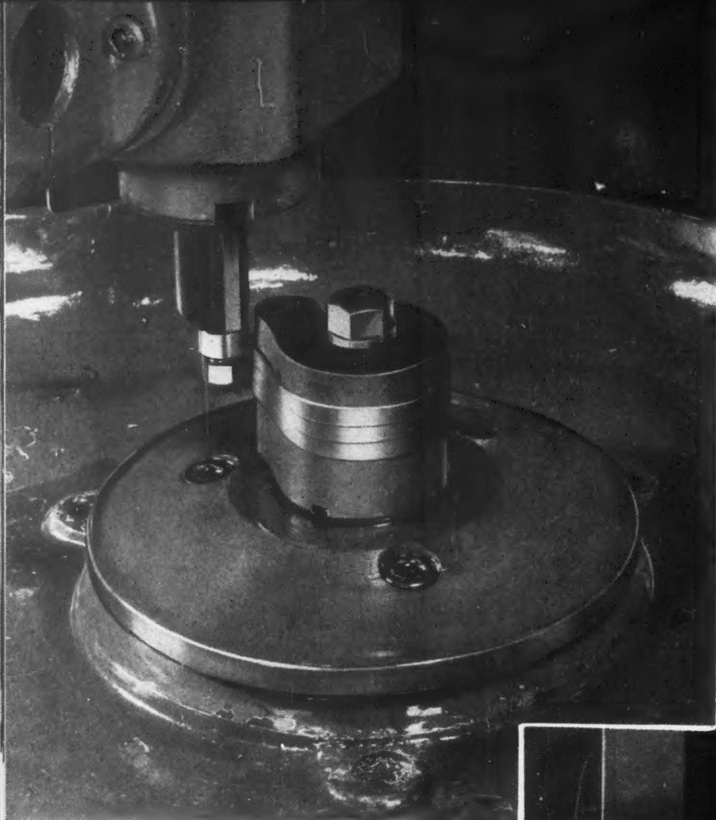


Fig. 1. (Left) Three cam blanks are shown mounted on the vertical mandrel of the special gear shaper seen in the heading illustration. The non-rotating cutter is reciprocated while the work is slowly rotated at varying speeds

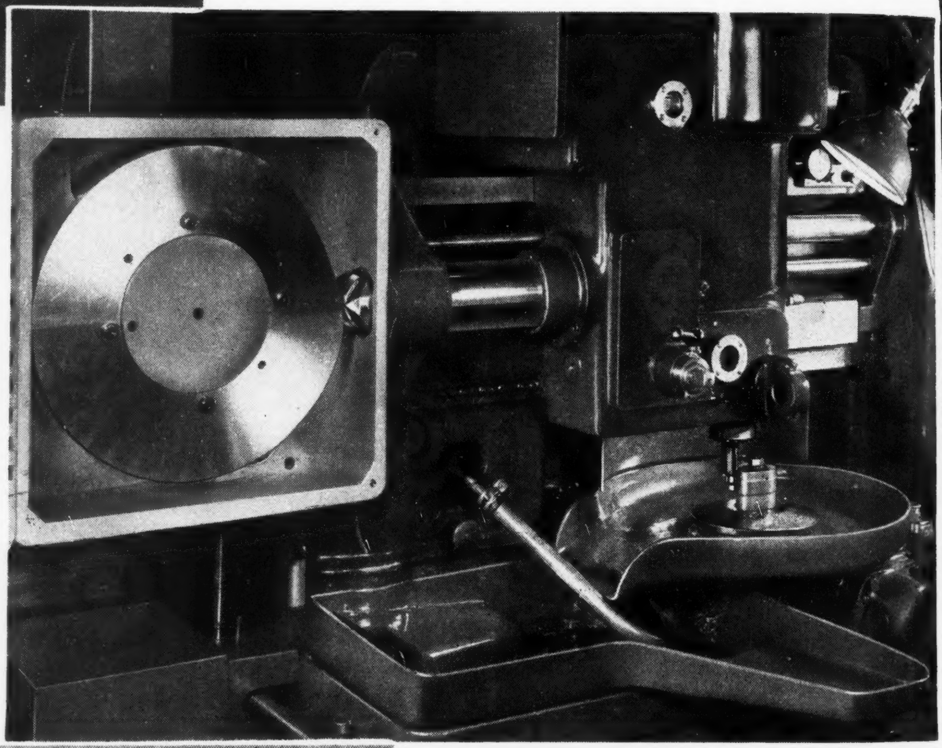


Fig. 2. (Right) An enlarged, inverted-shape master cam, seen at the left, is rotated at the same speed as the work being cut. A roller, which is kept in contact with the master by weighted chains, moves the cutter toward and away from the work

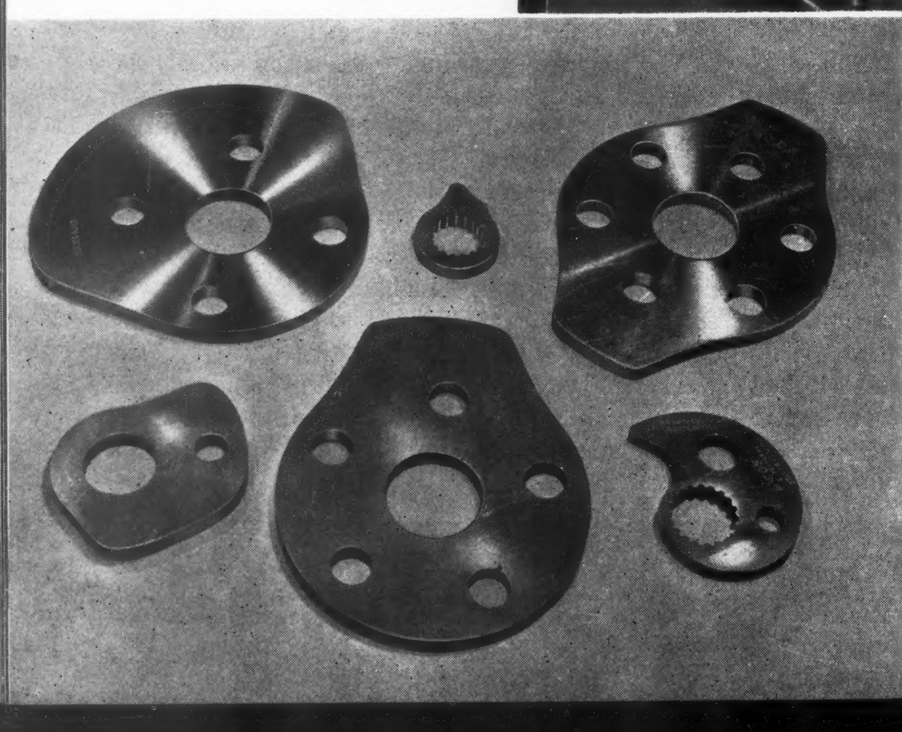


Fig. 3. (Left) Six of the more than forty inspection masters employed in final testing of the cams produced on the special gear shaper. The larger cams are cut sixteen at a time, while three or four of the smaller cams are machined simultaneously

sharp edge to the work. In the finishing cut, which is also completed in one revolution of the work, about 0.005 inch of stock is removed. From fifteen to thirty minutes is required to complete each group of three to sixteen cams.

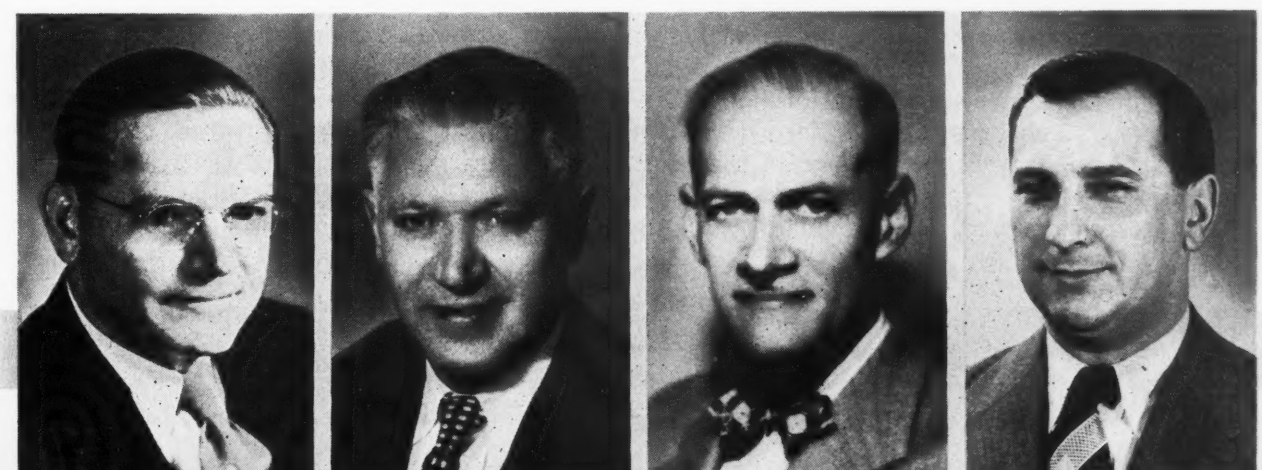
The cutter diameters vary from 3/4 inch to 3 1/8 inches. Cutter life is relatively short, due to the hardness of the material being machined. The periphery of each cutter can be used for approximately three roughing and three finishing cuts before resharpening is necessary.

By changing gears and the position of a belt on a two-step sheave, reciprocation of the cutter can be varied to any one of eight speeds between 50 and 300 strokes per minute. Maximum vertical travel of the tool, in cutting sixteen cams at one time, is 4 1/2 inches. Maximum center distance between the cutter and the work is 7 3/8 inches, and the highest rise that can be machined on any cam is 2 inches. Six of the inspection masters used in the final testing of the machined cams are shown in Fig. 3.

Some of the Men Who will Present Papers at the A. S. T. E. Meeting

(Above, Left to Right) George F. Eglinton, Vice-president, Lincoln Park Industries—"Carbide Die Developments"; C. L. Sadon, Manufacturing Engineer, Aircraft Gas Turbine Division, General Electric Co.—"Machining and Fabrication of High-Temperature Alloys"; Eugene Numrich, Application Engineer, Avey Drilling Machine Co.—"Application of Drill Units to Standard and Special Machinery"; and W. O. Sweeny, Jr., Assistant Sales Manager, Haynes-Stellite Division, Union Carbide and Carbon Corporation—"Metamics."

(Below, Left to Right) E. J. Vanderploeg, Development Engineer, Yoder Co.—"Cold Roll-Forming of Metals"; Herman Zorn, President, V & O Press Co.—"Automation in the Press Room"; O. W. Bonnafe, Chief Research Engineer, Lapointe Machine Tool Co.—"Broaching Applications for Cost Reduction"; and T. F. Frangos, Haynes-Stellite Division, Union Carbide and Carbon Corporation—"Investment Casting"



Marforming—Deep-Drawing and Forming without Wrinkles

Sheet Metal of All Kinds is Deep-Drawn and Formed to Compound Curvatures without Wrinkles, Using Inexpensive, Easily Changed Tools, as the Result of a New Metal-Forming Process Developed by the Glenn L. Martin Co., which is Applicable to Low- and High-Volume Production

By R. BURT SCHULZE
Supervisor of Manufacturing Research
The Glenn L. Martin Co.

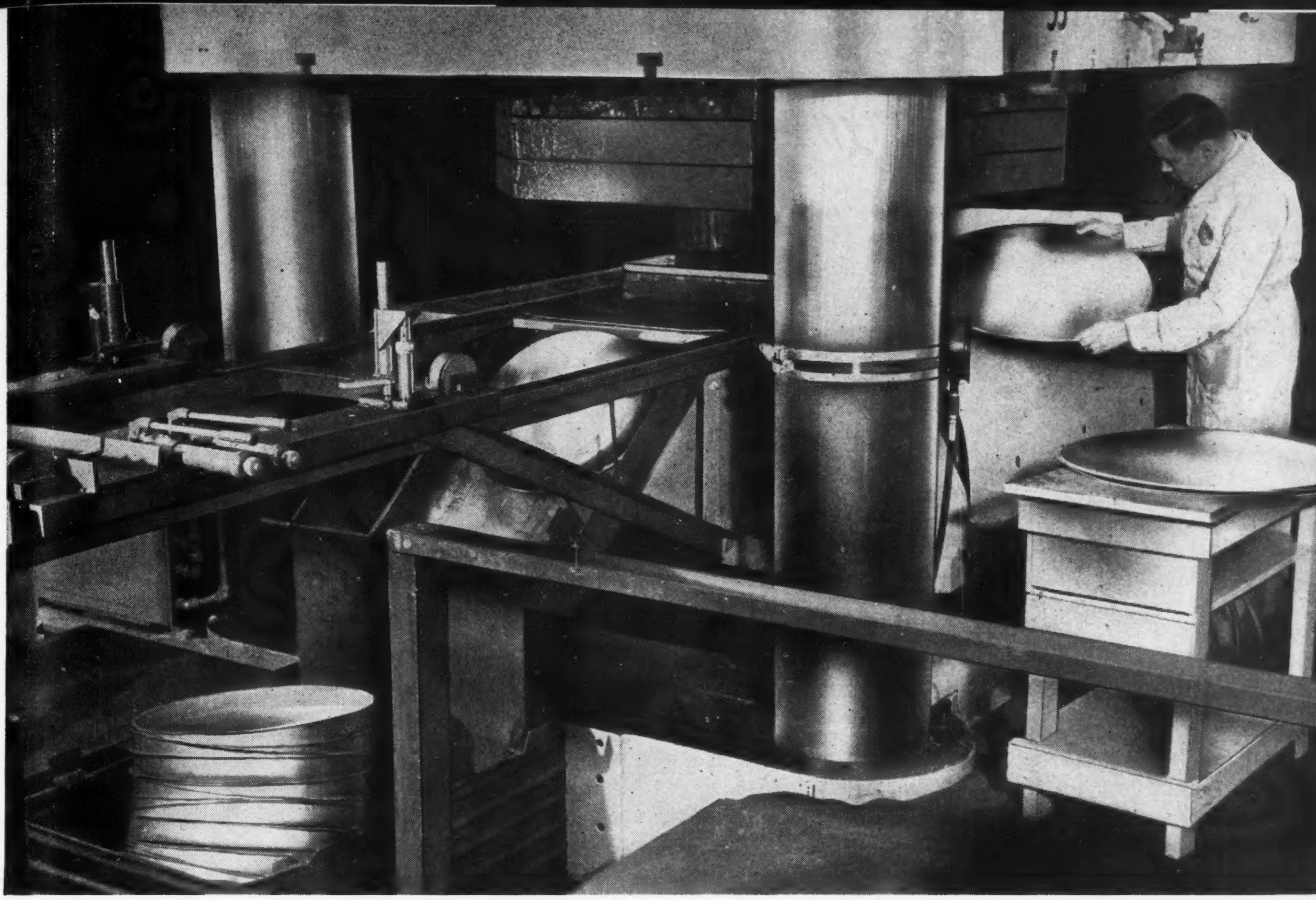
A HIGHLY efficient method of metal forming, known as the "Marform" process, has been developed by the Glenn L. Martin Co., Baltimore, Md., in order to reduce labor and tooling costs in the production of high quality stampings of various types in both large and small quantities. This process involves the use of a rubber forming cushion, combined with hydraulic equipment by means of which a close control can be maintained over the pressures employed in the forming cycle, thus preventing wrinkling of the work and reducing springback to a minimum.

Requiring no primary power source other than that supplied by the press, and without the use of expensive steel dies, complex sheet-metal parts involving drawing, shrinking, and stretching can be produced at rates ranging from 60 to 120 pieces per hour. This is accomplished on the relatively slow presses utilized in the original development of the process. The rate will, of course, be increased substantially as Marform units are installed on faster acting equipment.

In addition to drawing operations, the Marform process can be utilized to form and trim flanged parts, as well as to shear in the same operation. The shearing action can be parallel to the forming stroke, perpendicular, or at any angle. Shearing is accomplished without additional dies or expensive auxiliary devices.

A self-contained hydraulic unit (Fig. 1) is used in this process. This unit will be manufactured by Hydropress, Inc., New York City, as the result of an agreement with the Glenn L. Martin Co. The unit contains cam-operated valves through which a predetermined, regulated pressure is applied to the blank supporting plate to resist the forming pressure supplied during the down stroke of the press platen. The rubber retainer for this particular unit may be seen at the right in Fig. 1.

Fig. 2 illustrates the principle of construction of the Marform tool. Here it can be seen that rubber is employed as the female portion of the tool. This has several advantages, one of the most obvious being that the rubber provides a cushioning effect, thereby preventing the rapid application of strain at any point on the metal and avoiding excessive localized strains. The rubber also exerts a lateral pressure during the forming operation, as the direct result of the applied forming pressure. The lateral pressure has the effect of holding the formed metal tightly against the male portion of the tool, thus preventing concentration of strain at the punch radius and insuring a uniform distribution over



the complete surface of the piece to be formed. The importance of this is readily demonstrated by the fact that most steel-die formed parts that fail do so when the top breaks out of the part, with the failure along the line of the punch radius. By preventing concentration of strains at the punch radius, the part can be formed deeper and with more uniform wall thickness.

There is another advantage incident to the fact that the rubber holds the material tightly against the punch. This arises from the fact that local elongations in metal can safely be higher than elongations over a relatively long length. The rubber automatically causes the metal to be elongated over a much shorter length by gripping it just above the instantaneous point of forming.

Still another factor that enables the Marform process to form a deeper part in one operation is the ability to provide the exact pressure required on the material at each desired depth of stroke. This pressure can be varied in either direction. It can start low, be increased, and then drop off or gradually be increased from start to finish; on the other hand, it can be started high and then be dropped gradually. In some cases, it may be advisable to increase the pressure suddenly to the maximum available during the forming operation, in order to set a radius in a shoulder or perform a shearing operation. The pressure variation can be infinite within the minimum and maximum values; in other words, it is stepless. This means that there is no more resistance to the metal moving into the die cavity at any point in the forming operation than is necessary to prevent the formation of wrinkles in the flanges.

The precision with which a given shape can be formed is an important feature of this process. It is possible to make sheet-metal parts to a tolerance of $\pm$ 0.002 inch, and a tolerance of $\pm$ 0.005 inch is commonly obtained on parts where the shape is sufficiently rigid to maintain this accuracy.

The process is also advantageous on very thin materials, which are often difficult to form. Material as thin as 0.010 inch has been successfully formed, and a 0.012-inch cup was deep-drawn to the point where the depth of the cup was 0.9 of the diameter. Typical parts drawn in a single operation are shown in Fig. 3. The cup shown at the lower right is 5 inches long by 3 inches wide, and is made of 0.010-inch 3S-O aluminum. The rectangular box in the background was formed from 0.064-inch 3S-O aluminum. Aluminum-alloy sheets as thick as 0.675 inch and S A E 1010 steel sheets up to 0.102 inch thick

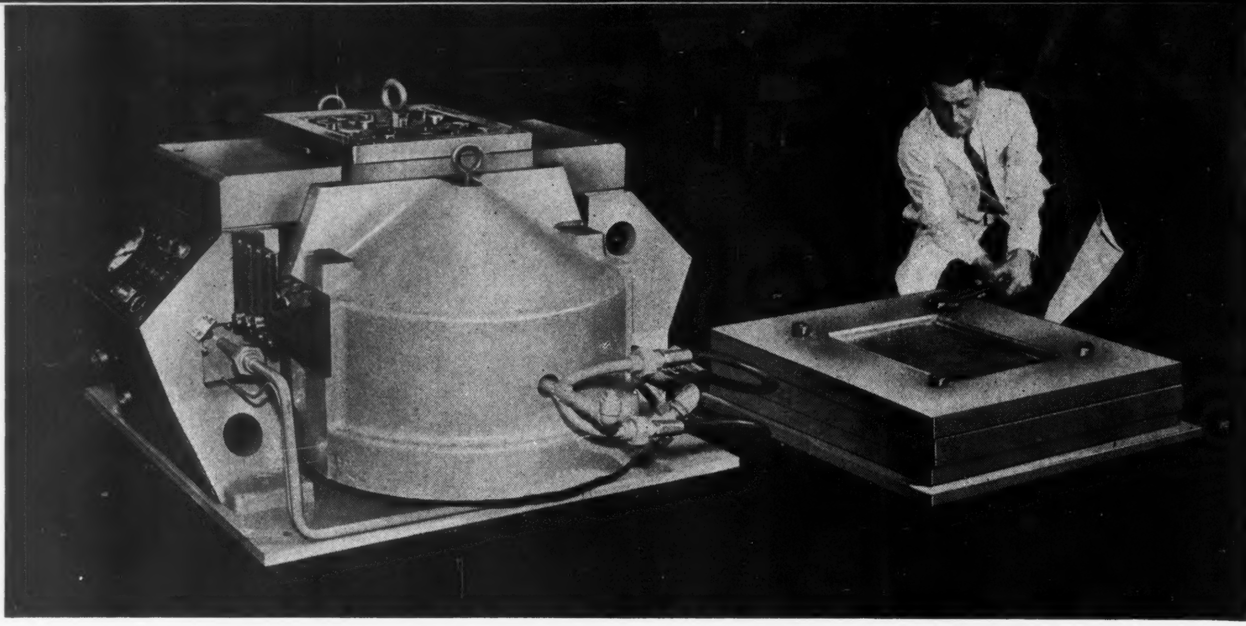


Fig. 1. A typical Marform unit that is used to apply a predetermined, regulated pressure to the blank supporting plate which resists the forming pressure supplied by the down stroke of the platen on hydraulic presses

have been formed. This is not necessarily the maximum, but represents the thickest gages formed up to the present. Two parts made with the same tool may be seen in Fig. 4. The cup at the right was formed from 1/4-inch thick 61S-O aluminum, and the one at the left from 0.030-inch S A E 1010 steel. Each was drawn in a single stroke.

The problem of applying finishes to formed shapes is sometimes critical from the economy standpoint. This is particularly true of polished surfaces. It is more economical to polish material in the flat state and then form the parts. However, this may result in marred finishes when ordinary forming processes are used. With the Marform method, round cups that had been previously coated with such finishes as vinyl, aircraft paints, and crackle paints have been formed successfully. This was also done with polished material.

Tapered shapes are a major forming problem, since any tapered part tends to wrinkle because of the distance between the punch and the pressure plates of the die at the start of the forming stroke. The following examples will indicate the severity of taper that can be formed without wrinkles by using the process described. Consider a 4-inch diameter on the top of a punch, with a taper outward toward the bottom. On such a punch, the gap between the punch and the supporting pressure plate could be 1/2 inch for steel 0.025 inch thick. This gap can be increased to 3/4 inch if the thickness of the steel is increased to 0.050 inch. The gap can be 3/16 inch with 0.025-inch aluminum, and 3/8 inch with 0.050-inch aluminum.

Marform equipment now in operation is employed on presses of 800 and 3500 tons capacity. The 800-ton press is used in conjunction with a unit which has a 16- by 18-inch forming area, providing a forming pressure of 5560 pounds per square inch. The 3500-ton press (shown in the heading illustration) is used with a 28- by 31-inch forming area, which offers a theoretical forming pressure of 8060 pounds per square inch. However, utilization of the maximum

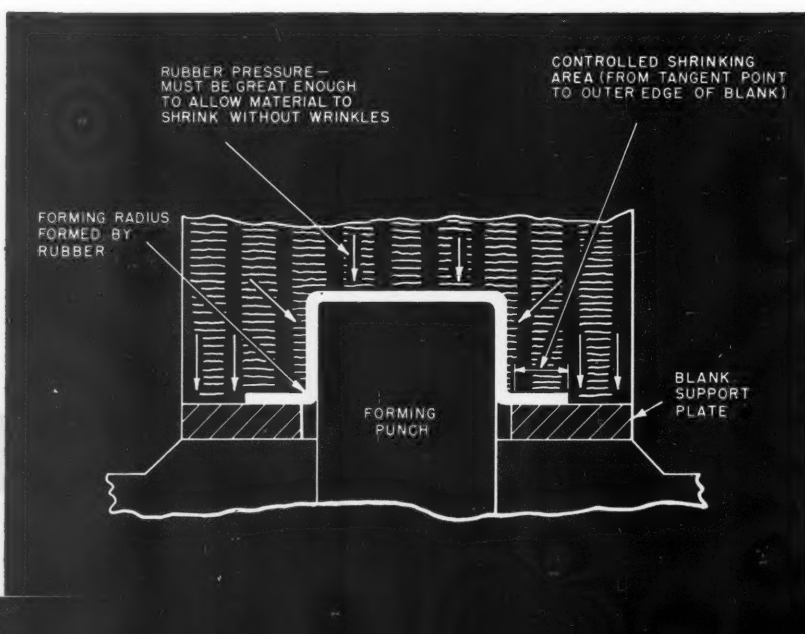


Fig. 2. The Marform tool utilizes rubber pressure around the part being formed, producing a cushioning effect that prevents the rapid application of strain at any point during the forming operation. The rubber also exerts a lateral pressure that holds the formed metal tightly to the form block or punch

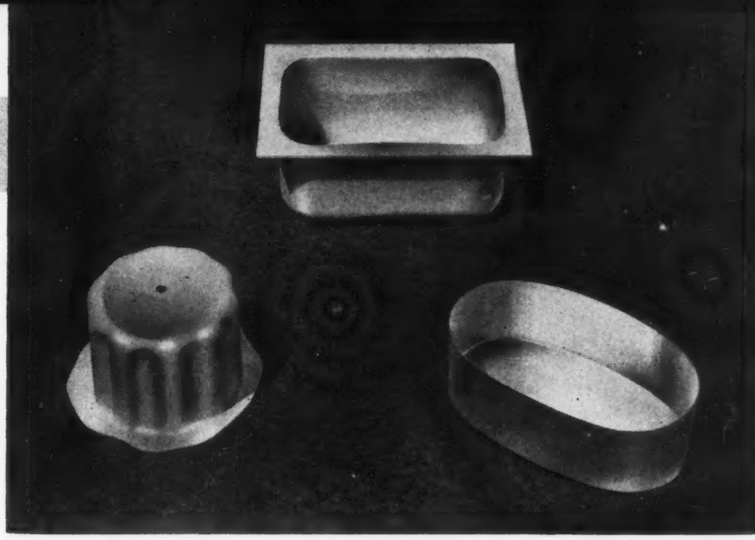


Fig. 3. Typical parts formed in a single operation using the Marform process. The part at the lower right is drawn from 0.010-inch thick 3S-O aluminum

pressure increases the maintenance cost of the equipment, so that this press is not used to provide more than 7000 pounds per square inch. These pressures can be directly translated into working pressure in the Marform unit itself. It may be of interest to note that a carrier equipped with two hydraulic jacks, as shown at the left, is provided to facilitate the removal of the large blank supporting plates. The carrier is run in to the tool on rails, so that the operator can lift the plate out by raising it on the jacks. The carrier, with the plate on it, is then run out from under the upper platen to the position shown in the illustration. An overhead monorail is used to remove the heavy plate and a new one may then be placed on the carrier for assembly with the tool.

The smaller press operates at 120 cycles per hour, which in many cases results in a multiple of that number in pieces per hour, since more than one piece is often formed at one time. The large press operates at a speed of 60 cycles per hour, which can, of course, also be multiplied by the addition of more parts in the same stroke. The speed of operation is based entirely upon the speed of the hydraulic press equipment on hand. No attempt has yet been made to apply a Marform unit to a mechanical press, but there is no reason to believe that such an application would be unsuccessful if the press had sufficient daylight opening and proper power.

Since the controls of the unit have been designed to provide infinite variations of forming pressure, from practically zero to the maximum values obtainable on a press, and the pressure variation is directly correlated to the stroke position of the machine, any desired pressure pattern can be applied to the shape of the part to be formed. The controls may be seen at the right in Fig. 5.

With the conventional rubber-forming methods where rubber is employed as the female portion of the tool, no pressure is applied before the press platen starts moving. Thus wrinkles can form in the metal with the initial movement of the platen. When steel dies are used, a given pressure must be employed through springs and air cylinders, and there is little control over this pressure during the forming operation. With the Marform process, pressure is built up in the machine by the movement of the platen before any forming of the metal takes place, which prevents wrinkles from forming.

As will be understood from the foregoing, the Marform process combines the efficiency of a steel forming die with the economical tooling of the rubber forming methods. For example, this process utilizes the same simple male punch employed in other rubber forming methods, and it is therefore unnecessary to make either a female die, pressure plate, or draw-ring. This saves more than half the cost of the tool, as compared with the use of steel dies, for the following reasons: First, the female portion of the tool is often the hardest to make, since it is more difficult to work in a hole; second, and most impor-

Fig. 4. Two parts, each made in a single stroke with the same Marform tool. Part at right is produced from 1/4-inch 61S-O aluminum, and that at left from 0.030-inch SAE 1010 steel

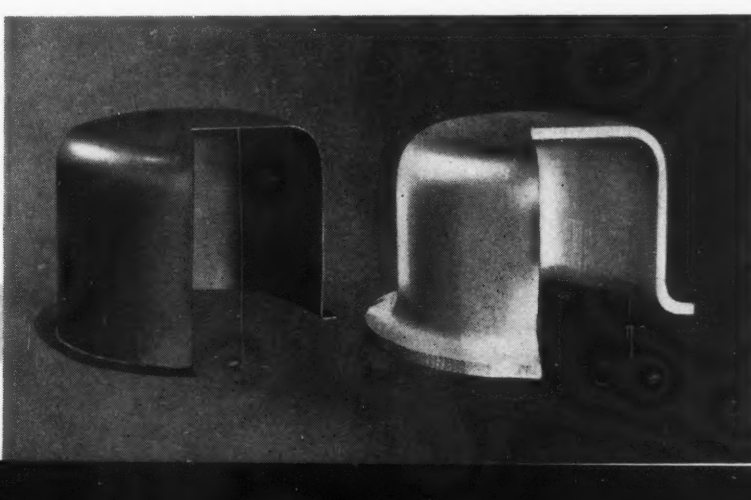


Fig. 5. Convenient pressure controls on the Marform unit are adjusted to vary resistance to forming pressures

tant, is the fact that fitting of the two halves of the tool has been eliminated.

The Marform punch can be made of Masonite for short runs on soft materials. Cast Kirksite can be employed for longer runs and harder materials. However, steel punches are generally employed for production runs, especially on the harder materials. The flat plate on which the metal rests is always made basically of steel, but a thin Masonite overlay is often employed on the steel plate for short runs to save the cost of grinding the steel. This plate must be flat and smooth, but the fit between it and the punch is unimportant, except when forming very thin metal, say, 0.010 or 0.020 inch thick. The inside periphery of the plate, where it surrounds the punch, and the outside periphery of the plate can be torch-cut except in cases where very thin metals are to be formed.

With the Marform process, the set-up time on a tool is relatively small, since the male and female portions of the tool do not have to be matched and since more than one form block can be used in the pressure plate of the unit or in separate pressure plates on the same machine. The pressure requirements and depth of stroke must, of course, be equal, however, for all parts formed at the same time.

A 40 per cent reduction in area is generally expected with a steel die when forming aluminum alloys, for example; and a reduction in area of 50 per cent can be attained if extra care is taken. However, a reduction in area of 57 per cent is considered normal with the Marform method on the same material, and a figure as high as 70 per cent has been attained in testing operations.

In like manner, a cup depth equal to the radius is normally expected from a steel die, while a depth equal to 1 1/2 times the radius is expected with the new process on the same material;

Fig. 6. Deep aluminum cups, 5 1/8 inches outside diameter and 5 1/8 inches deep, are rapidly drawn in a single stroke with this Marform unit on a standard hydraulic press

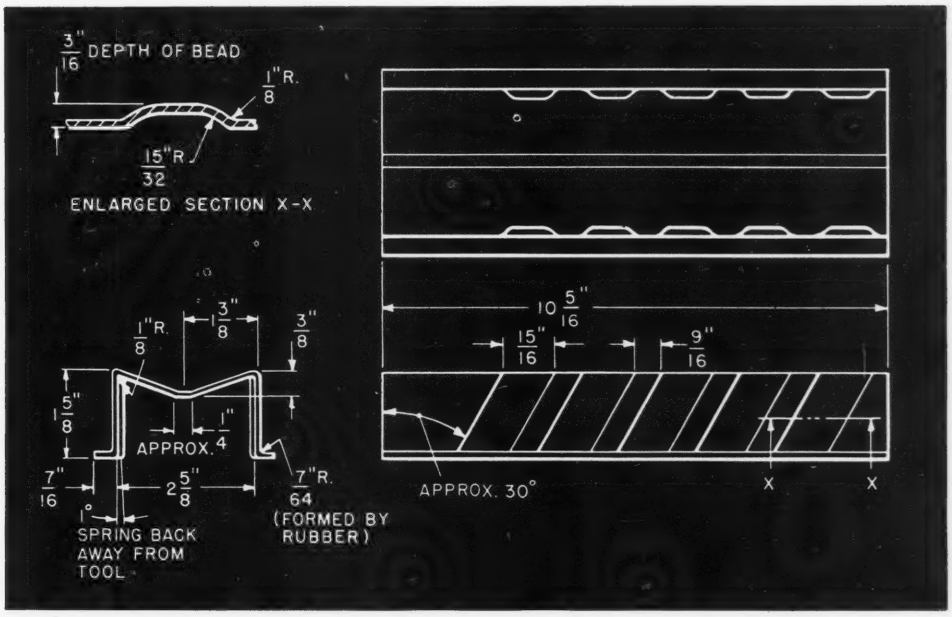


Fig. 7. Bracket stamping, which is afterward cut in two pieces to provide two brackets, is formed of 0.040-inch 24S-O aluminum in one stroke

depths equal to 1.2 times the diameter, or 2.4 times the radius, have been attained in certain cases. This means that the Marform process can sometimes form a part in one operation that would otherwise require two. For example, deep cups, such as the one shown in Fig. 6, are drawn at the rate of sixty per tool per hour without wrinkles in a single draw. This part would require two draws using conventional methods.

Fig. 7 illustrates another typical part easily formed in a single draw with the new process. Because of the slanted beaded flanges, this 0.040-inch 24S-O aluminum part would be extremely difficult to produce by ordinary methods. The large cup shown in Fig. 8 is another example of what can be accomplished by the Marform process. This part was cold-formed in one operation, starting with an aluminum blank 22 inches in diameter. A 23 1/2-inch diameter blank was successfully formed on this same 10-inch diameter punch. The average flange width, after drawing to a depth of 8 3/8 inches, was 1 1/4 inches. A wall thickness within 5 per cent of the original material thickness was maintained.

In addition to the advantages mentioned in the foregoing, the newly developed process provides an economical means of forming parts where frequent changes in design are made. It also eliminates finish-forming of parts by hand, and enables several different parts of complicated contours, with similar pressure curves, to be formed at the same time. Moreover, parts of various materials with different thicknesses can be formed, within a reasonable range, without requiring a change in tooling. It should be added that the Marform process can be readily adapted for hot-forming where required.

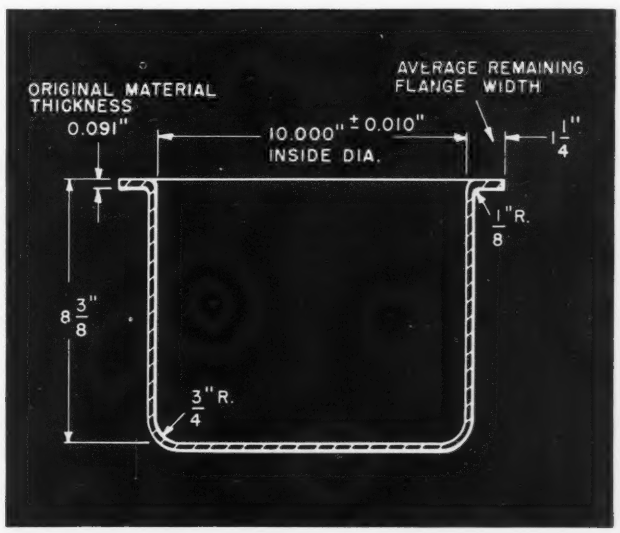


Fig. 8. This large aluminum cup, drawn cold to a depth of 8 3/8 inches, maintaining a uniform wall thickness, is a typical example of work done in a single draw with the Marform process

Rotary Broaching—New Technique for Finishing Stampings

Improved Surface Finish, Rapid Production, and Accuracy are Obtained by the Rotary Broaching of Sheet-Metal Stampings. This New Method of Manufacturing Requires Inexpensive Tooling and the Broaches Have a Long Life

By R. E. COLES
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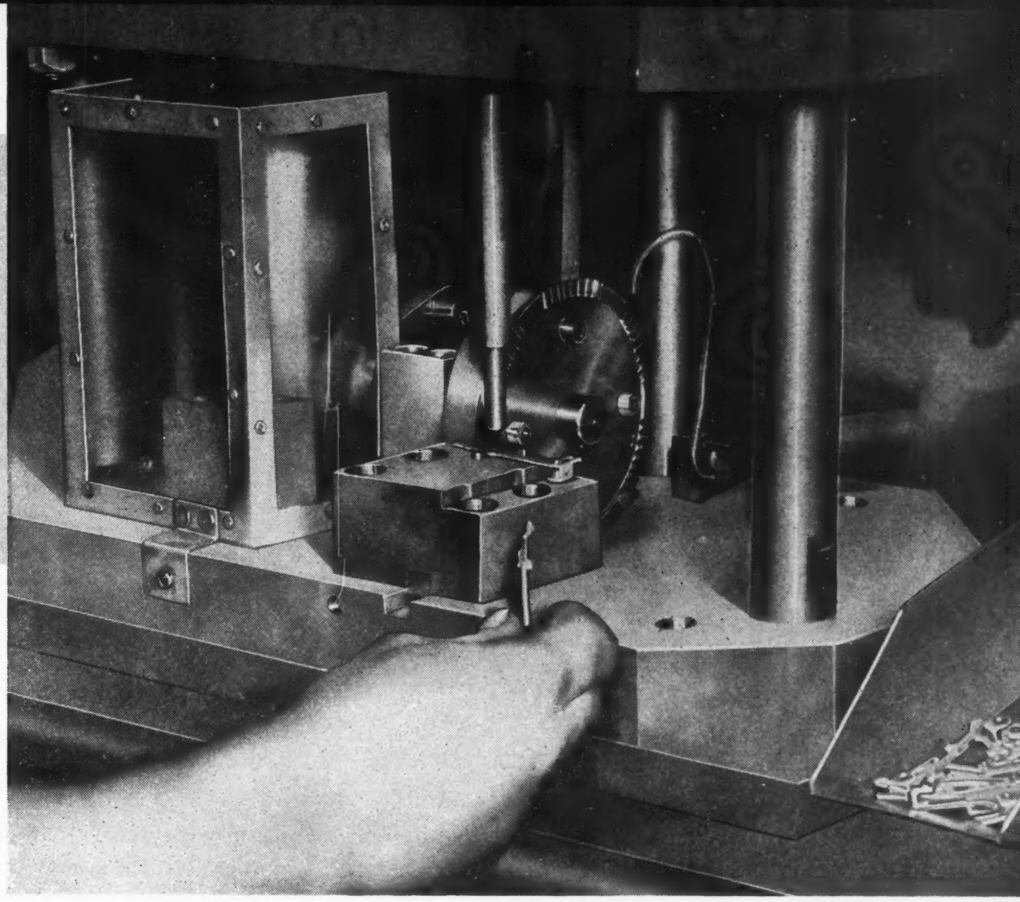
International Business Machines Corporation
Endicott, N. Y.

ONE of the principal production problems encountered at the International Business Machines Corporation is the economical manufacture of high quality parts in relatively small quantities. Many thousands of different parts are required for the various models and sizes of accounting, statistic, time-recording, and document-preparation machines made by this company. Since such elaborate machines are required only in limited quantities, and often must be designed to suit individual needs, the component parts are necessarily produced in small lots. This complicates production by requiring frequent set-up changes.

To offset the normally high cost of small-lot production, full use is made of cost-cutting manufacturing machines and methods. One such method, widely employed at the Endicott, N. Y., plant of the company, is surface broaching. The advantages of surface broaching, such as rapid stock removal, low production cost per piece, high repetitive accuracy, and smooth surface finishes, have resulted in the adoption of this process by many industries for the mass-production machining of castings, forgings, and large parts. Broaching, however, can also be applied economically to the low-volume production of small intricately shaped parts or sheet-metal stampings.

Trimming or shaving operations on sheet-metal stampings that require a high degree of accuracy and smooth surface finishes can be eliminated by broaching. A standard work-holding fixture has been developed to permit broaching various parts on any of the available horizontal or vertical broaching machines. The small parts can be accurately broached in two or more planes and on several different surfaces in one setting. By combining operations and completing the part with one stroke of the broach, the cost of manufacturing is reduced. Sometimes the parts are of such shape that they can be stacked and broached in multiple.

Rotary broaching is a new method of manufacturing, developed by engineers at the International Business Machines Corporation, that permits the machining of straight surfaces on sheet-metal stampings to close tolerances and with finishes better than those obtainable by conventional methods of shaving. This method incorporates principles of both milling and broaching operations, making use of a revolving radial type cutter, as in milling, and step-up type teeth, as in broaching.



Rotary broaching fixture employed to finish latch surface (X) of the stamping seen in Fig. 3

A group of rotary broaches is shown in Fig. 1. As can be seen, there are several identical sets of radially gashed teeth around the periphery of each broach, the sets being separated by a "non-cutting" gap. Each part is completely broached by one set of teeth in a partial revolution of the cutter. A brief time interval, or dwell, is provided between broaching strokes during which the completed part is ejected by semi-automatic or automatic means, and the work-holding fixture is reloaded. Since an unbroached surface is presented to each successive set of teeth, the broach does not have to be returned to its starting position or relocated. Idle time between cuts is thus kept at the minimum required for simple loading.

In rotary broaching, the amount of stock to be removed from each part ranges from about 0.005 to 0.008 inch. Since each tooth removes only from 0.0005 to 0.002 inch of stock, the total tool life and the life between sharpenings of the broach are relatively long for the finish and accuracy obtained. The last few teeth in each set are generally made the same height. These teeth remove no metal, but perform a burnishing or cold-working sizing operation which smooths out any fine surface irregularities.

By producing the proper shearing action, the formation of burrs is minimized. The tooth form is essentially the same as that of a conventional broach. Shear is varied to suit the part to be broached, additional shear being obtained by setting the part so that the surface to be broached is above or below center.

A high degree of accuracy can be produced consistently, and the relative location between various surfaces on the part can be maintained within close tolerances. Tolerances of 0.001 inch are frequently specified on surfaces that are to be rotary broached. Surface finishes as smooth as 8 micro-inches r.m.s. have been produced on sheet-metal parts by rotary broaching, and finishes of 16 micro-inches maximum are consistently obtained in production.

The fixtures employed for rotary broaching are simple and inexpensive. The broach is rotated intermittently by means of a rack and pinion and ratchet mechanism that is actuated either by the reciprocating ram of the press, Fig. 2, or a pneumatic or hydraulic cylinder. Since the main force of the broaching cut is downward, pressing the work-piece against the base of the fixture, only light clamping pressures are required.

An air-actuated, bench type rotary broaching fixture, shown in the heading illustration, is employed to machine latch surface *X* of the sheet-metal stamping seen in Fig. 3. The part, a ratchet type counter-clutch lever for an electric, punched card accounting machine, is made from

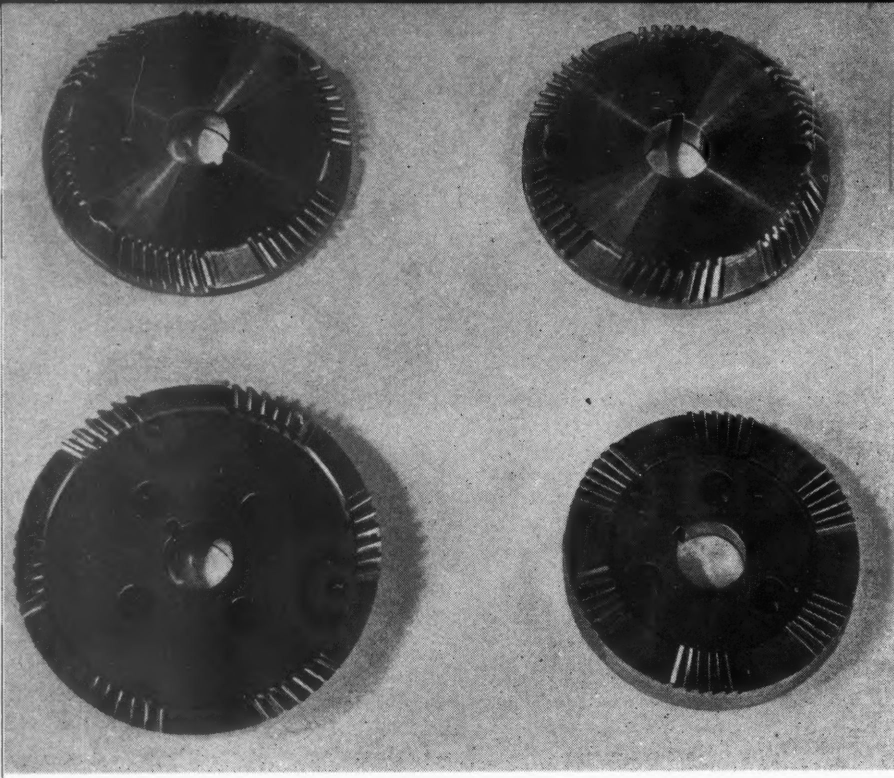


Fig. 1. Group of rotary broaches used to machine straight surfaces on sheet-metal stampings within close tolerances and with smooth surface finishes

SAE 1010 cold-rolled steel, and is copper-plated all over before machining. Tolerances that must be maintained on the size and location of the latch are indicated on the drawing. Surface *X* must be parallel with the center lines of the holes in the part within 0.001 inch. Corners on the latch must be finished smooth, with a maximum radius of 0.003 inch. A surface finish of 16 micro-inches r.m.s. is specified.

As shown in Fig. 4, work-piece *A* is placed on locating block *B*, with the lower hole in the part on pilot-pin *C*. A flat spring *D*, screwed to the front of the locating block, clamps the work-piece against stop-pin *E*. Air cylinder *F*, actuated by a foot-valve beneath the bench on which the fixture is mounted, forces rack *G* downward, thus rotating pinion *H* one-sixth of a revolution. Pinion *H* and cam *J* to which the pinion is doweled are freely mounted on shaft *K*. Pawl *L*, which is pinned to the cam, rotates ratchet wheel *M*. The ratchet wheel, broach-holder *N*, and rotary broach *O* are all keyed to shaft *K*, and therefore are rotated one-sixth of a revolution for each downward stroke of the rack.

On the up stroke of the rack, the ratchet wheel, broach-holder, and broach remain stationary while the pinion and cam rotate in the opposite direction, returning to their original positions. The pawl falls into the next notch on the periphery of the ratchet wheel, and the cycle is ready to be repeated. Spring *P*, hooked over studs in the pawl and cam, keeps the pawl in contact with

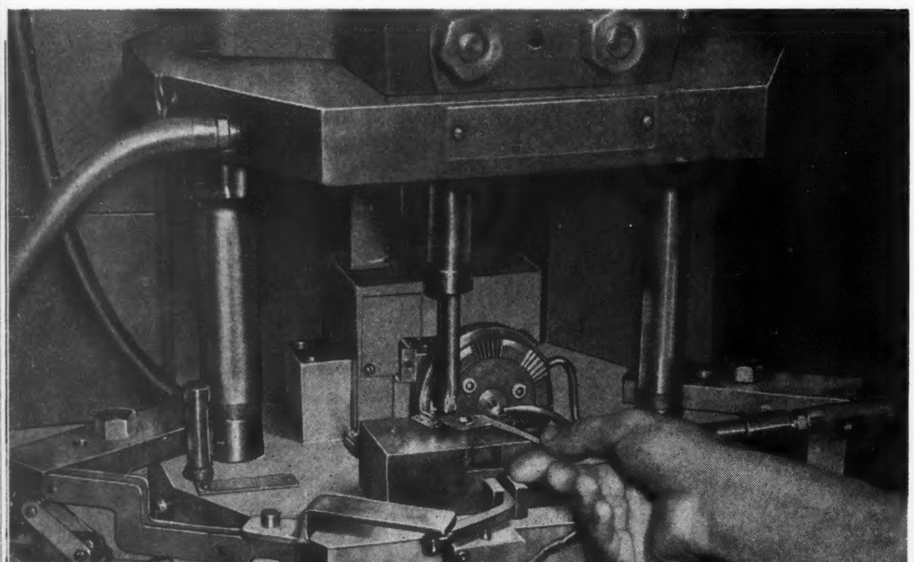


Fig. 2. Rotary broaching fixture in which the broach is rotated intermittently by means of a rack-and-pinion and ratchet mechanism actuated by the reciprocating press ram

Fig. 3. (Right) Surface (X) of this ratchet type counter-clutch lever is machined to the tolerances shown by means of the rotary broaching set-up illustrated in Fig. 4

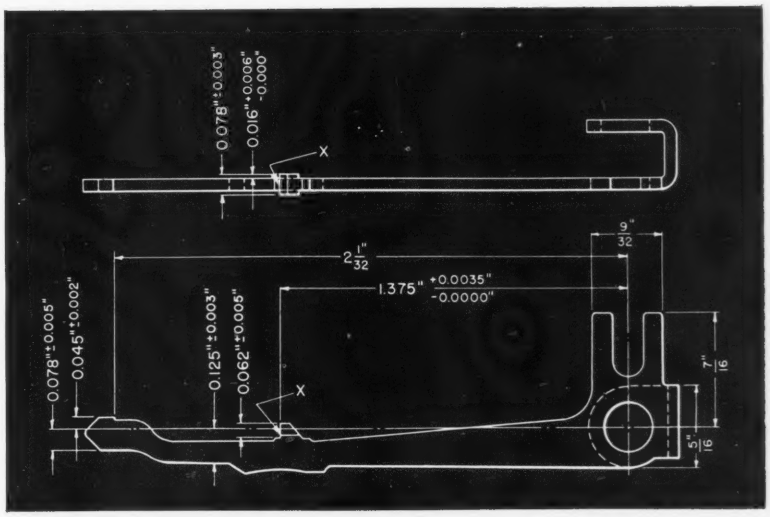
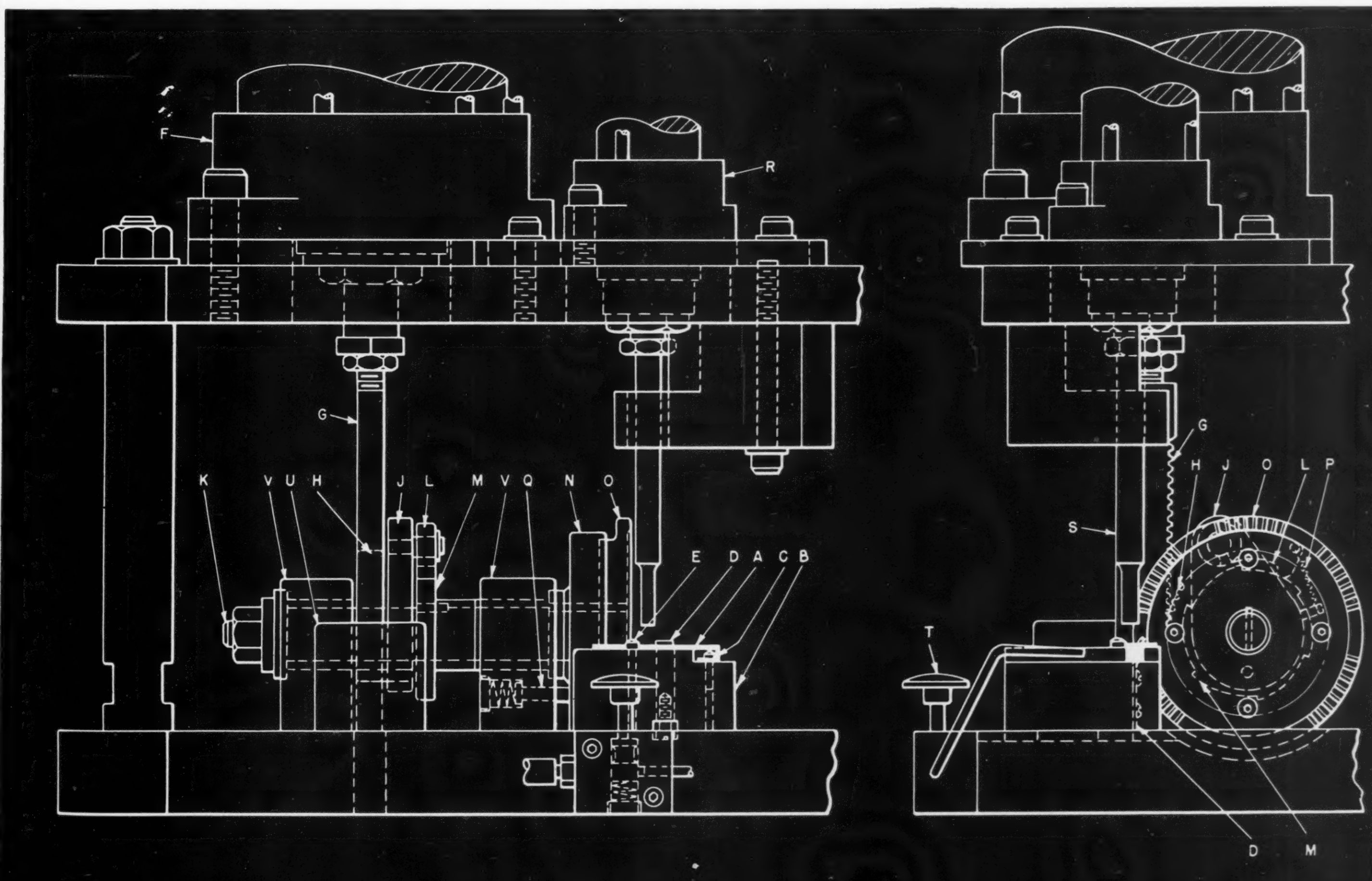


Fig. 4. (Below) Bench type rotary broaching fixture in which air cylinders are employed to clamp work-piece (A) and actuate the mechanism which rotates broach (O) intermittently

the ratchet wheel. A spring-loaded detent Q progressively enters each of six holes provided in the rear face of the broach-holder to prevent the broach from rotating during the up stroke of the rack or while loading the next part to be broached.

Air cylinder R, actuated at the same time as cylinder F, forces ram S downward to clamp the work-piece against block B during the broaching operation. When the rack and clamping ram have been raised, hand-knob T is depressed, thus releasing a blast of air which lifts the broached part from pin C and blows it out the back of the fixture. Slotted block U serves as a rack guide, and bearing blocks V support the shaft, pinion, cam, ratchet wheel, broach-holder, and rotary broach. The same fixture can be employed for broaching other parts by simply changing the broach and broach-holder and substituting a suitable locating block B.

A detail drawing of broach O is seen in Fig. 5. The rotary broach is made from high-speed steel, heat-treated to attain a hardness of from 64 to 66 Rockwell C, and ground. Six sets of cutting



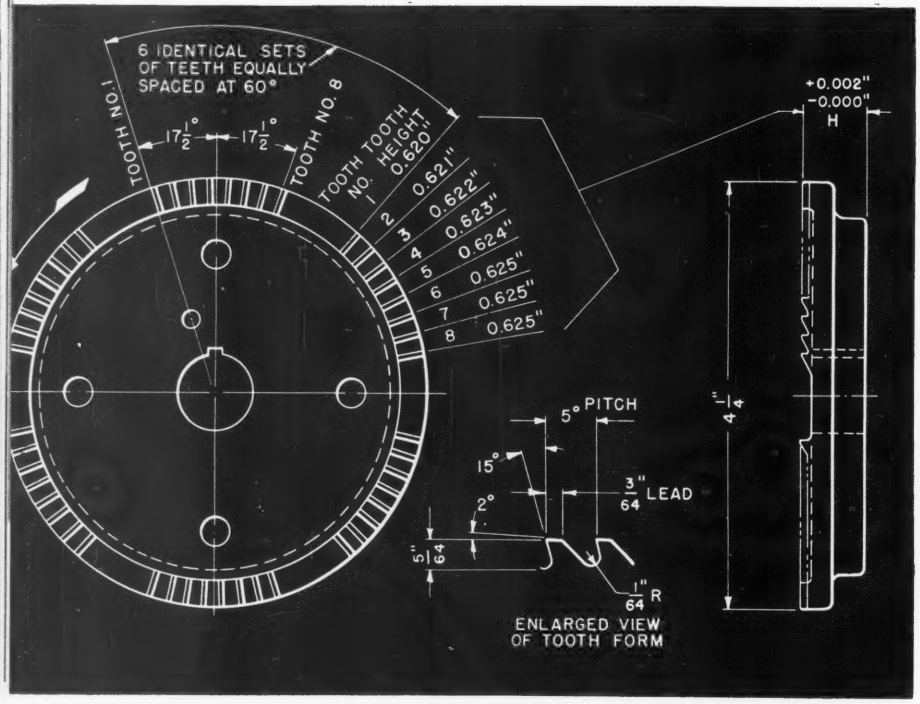


Fig. 5. Details of the rotary broach (O) used on the fixture seen in Fig. 4 to machine surface (X) of counter-clutch lever, Fig. 3

teeth are provided on the broach, each of which contains eight teeth. Thus six work-pieces are finished for each revolution of the broach.

Cutting teeth on the rotary broaches are gashed radially, or at a shear angle to the center of the broach. The angle of shear during broaching, and the direction of burr formed on the part can also be controlled by setting the center of the rotary broach above or below the surface being machined. The over-all height of the teeth is ground to the *H* dimensions given on the drawing. The last three teeth in each set are the same height. After sharpening, shims are provided between the broach and the broach-holder to maintain these heights.

Since each of the cutting teeth removes only about 0.001 inch of stock (with the exception of the last two teeth, which remove none), there is very little wear on the broach. The life of one of these cutters is estimated to be good for broaching approximately 1,000,000 pieces. As many as 50,000 to 60,000 counter-clutch lev-

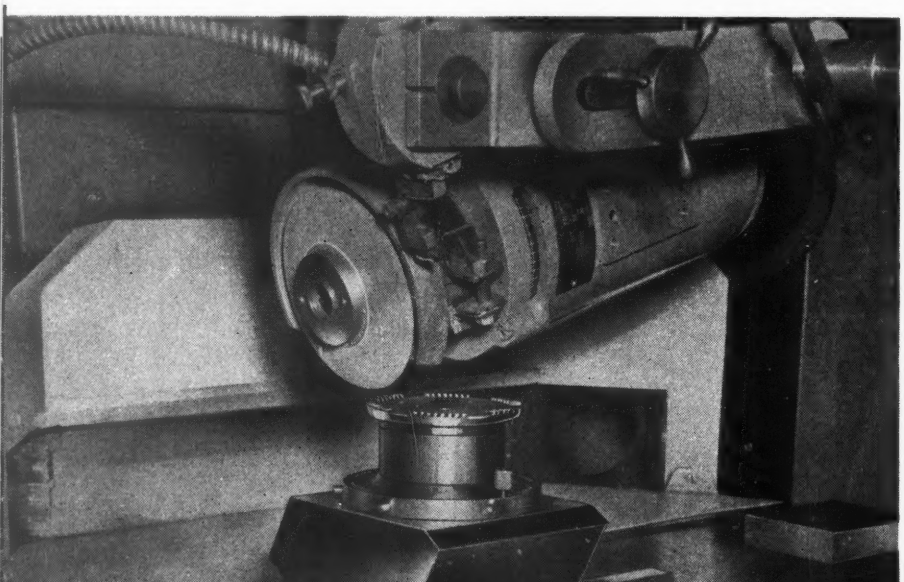


Fig. 6. Grinding set-up employed for sharpening teeth of rotary broaches. The base of the indexing fixture has angles on which the fixture rests when grinding various surface angles on broach teeth

ers are machined before sharpening of the broach is necessary. The number of parts broached between grinds could be increased even more by using a carbide inserted-tooth broach. However, since only a small amount of stock is removed and since different cutters have been used for broaching several hundred thousand parts without wearing out, carbide broaches have not yet been made.

Additional stock can be removed by decreasing the number of sets of teeth in the broach and increasing the number of teeth per set or by increasing the diameter of the broach and increasing the number of teeth per set. In either case, a longer stroke of the press ram or air-cylinder piston would be required. To broach more than one surface on a part at a time, several broaches can be mounted on the same shaft.

Rotary type broaches are sharpened with standard broach sharpening equipment. A special fixture, Fig. 6, is used to hold the cutter and to index from tooth to tooth. For shaping or gashing the tooth form, a No. 12, 60-grit, aluminum-oxide wheel of J hardness is used. A No. 12, 320-grit, silicon-carbide wheel of the same hardness is used to finish-form the contour of the tooth gash.

The step-up of the teeth is produced with a No. 11 flaring cup aluminum-oxide wheel of 46 grit and K hardness. The finish-ground tooth is obtained by using a No. 12 silicon-carbide wheel of 320 grit, J hardness and shellac bond. Finish on the broaches varies from 6 to 12 micro-inches r.m.s.

Parts similar to the ratchet type counter-clutch lever illustrated are produced by means of rotary broaching at the rate of approximately 425 pieces per hour, compared with 70 per hour by lapping. Production obtained from rotary broaches now in use at this plant ranges from 400 to 1500 pieces per hour, depending upon the adaptability to loading and unloading.

Economic Forum to be a Feature of the A. S. T. E. Meeting

ONE of the outstanding features of the A.S.T.E. meeting, to be held in connection with the Industrial Cost-Cutting Exposition, will be an Economic Forum sponsored by the American Society of Tool Engineers in cooperation with a Committee of Publishers. This committee consists of Chairman J. S. Hildreth, president of the Chilton Co.; Robert B. Luchars, president of The Industrial Press; and E. L. Shaner, chairman of the Penton Publishing Co. The Economic Forum will be held at the Academy of Music, Philadelphia, Pa., on April 10 at 8:15 P.M. Members of the forum are Dr. Edwin G. Nourse, chairman; Edward T. Cheyfitz; Joseph A. Livingston; and Dr. C. Canby Balderston.

Dr. Nourse was the first man to serve as chairman of the Council of Economic Advisers to the President (from 1946 to November 1949), and is considered one of the leading economists of the country. Dr. Balderston, Dean of the Wharton School of Finance and Commerce, is an outstanding authority on industrial relations from an economic standpoint. Mr. Livingston is the writer of the column "Business Outlook," which is published by more than sixty major newspapers; at one time, he was editor of *Financial World*. Mr. Cheyfitz is the youngest man ever to have been elected to the National Executive Board of the CIO. At the present time, he is assistant to Eric Johnston, president of the Motion Picture Association.

An address of welcome will be given at the opening of the Economic Forum by Robert B. Douglas, president of the A.S.T.E. Paul Wooton, president of the Society of Business Magazine Editors, past president of the White House Correspondents' Association, and past president of the National Press Club, will introduce the various speakers. Walter D. Fuller, president of the Curtis Publishing Co. and chairman of the National Association of Magazine Publishers, Inc., will give the keynote address.

STOCK cutting-off operations have generally been performed in past years with little attention to the cost per piece, but the high labor and overhead costs of today have made the expense for cutting-off work an important factor in the operation of a machine shop. In arriving at the true cut-off cost per piece, it is necessary to consider the time required for cutting off; the number of machines that a man can operate at one time; whether or not secondary operations are necessary to produce a usable finish on cut-off ends; and the tool cost.

Circular sawing of metals is accomplished by using a relatively thin saw blade, which is fed through the work at milling speeds and feeds. The process provides for cutting off with a minimum loss of material and at comparatively high speeds. The cut-off ends are left with a smooth "milling machine" finish and few or no burrs. Pieces are cut off without any change in the physical or metallurgical characteristics of the stock ends.

With present-day equipment, a 6-inch diameter bar of S A E 1020 steel can easily be cut off in a minute, leaving the ends of the individual pieces square and parallel. By using accurate saw blades and stock feeding devices, smaller sizes of stock can be cut to specified lengths within 0.010 inch. In the operation shown in Fig. 1 being performed on an automatic circular sawing machine, 1 1/4-inch round bars of S A E 1020 steel are being cut to lengths of 2 1/2 inches in thirteen seconds per piece.

Successful circular sawing is dependent upon a number of factors, the most important of which are the proper selection of the saw blade, cutting speeds, and saw feeds for the material being cut. In order to cut a given section, the pitch of the saw teeth—that is, the spacing between the cutting edges of adjacent teeth—must be sufficiently large to allow enough gullet space for storing chips during a long cut. Table 1 can be used as a guide in deciding upon the approximate tooth pitch to be used in the production sawing of different sizes of work. In sawing the harder types of metals—having a Brinell hardness number of

Factors Important to Low-Cost Circular Sawing

By W. T. GLOOR
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Cleveland, Ohio

250 to 375—it is generally advisable to select a tooth pitch at the lower end of the range.

Circular sawing machines are usually furnished with a definite range of feeds and speeds for cutting either ferrous or non-ferrous metals. The cutting speeds and feeds generally recommended for various types of materials are listed in Table 2. As a rule, the lower speeds and feeds are used in sawing the harder materials and larger stock diameters. In sawing thin-walled tubing, the higher cutting speeds are sometimes employed, and the saw feed increased as much as 100 per cent over the feed recommended for solid bars of the same diameter.

For general-purpose sawing, the tooth rake angle *R*, Fig. 2, should be from 15 to 20 degrees, with the top clearance angle *T* from 7 to 11 degrees. In some instances of production sawing, the saw blade life can be extended by changing the rake and the top clearance angles. Table 3 gives tooth angles that may be used in the production sawing of various materials.

Saw blades are generally segmental in design. This allows teeth to be ground into solid high-speed steel segments that have been accurately fitted to a center disk. Should any teeth become broken, it is far more economical to replace a segment than it would be to provide an entirely new saw. Solid high-speed steel saw blades are generally made in sizes up to 20 inches in diameter for cutting off the smaller sizes of stock. Carbide-tipped saw blades are a development of recent years, and are being used in some non-ferrous sawing applications.

Fig. 1. Automatic circular sawing machine that cuts off 1 1/4-inch round bars of SAE 1020 steel at the rate of thirteen seconds per piece

Table 1. Pitch of Circular Saw Teeth for Production Sawing

Solid Stock Diameter, Inches	Pitch Range, Inches	
	Ferrous Metals	Non-Ferrous Metals
1/8 to 1/4	0.10 to 0.22	0.10 to 0.22
1/4 to 1	0.20 to 0.35	0.20 to 0.35
1 to 2	0.30 to 0.55	0.30 to 0.55
2 to 3	0.50 to 0.65	0.50 to 0.75
3 to 4	0.60 to 0.75	0.70 to 0.85
4 to 7	0.70 to 0.95	0.80 to 1.25
7 to 9	0.90 to 1.15	1.15 to 1.55
9 to 15	1.10 to 1.55	1.30 to 2.50
Tubing, Wall Thickness, Inches	**Pitch Range, Inches Ferrous and Non-Ferrous Metals**	
1/32 to 1/8	0.10 to 0.20	
1/8 to 1/4	0.20 to 0.30	
1/4 to 1/2	0.30 to 0.50	
1/2 to 1	0.50 to 0.80	
1 to 1 1/2	0.80 to 1.10	

Table 3. Rake and Top Clearance Angles of Saw Teeth for Production Sawing

Material to be Cut	Rake Angle, Degrees	Top Clearance Angle, Degrees
Aluminum, soft	20 to 30	10 to 15
Aluminum, hard	15 to 20	9 to 11
Copper	15 to 25	10 to 15
Stainless Steel	10 to 15	9 to 11
Brass	15 to 20	9 to 11
Cast Iron	5 to 10	7 to 9
Low-carbon or Low-alloy Steel	15 to 20	9 to 11
Medium-carbon or Medium-alloy Steel	10 to 15	9 to 11
High-carbon or High-alloy Steel	5 to 10	7 to 9

Table 2. Circular Sawing Speeds and Feeds

High-Speed Steel Saw Teeth

Material to be Cut	Solid Stock Diameter, Inches	Brinell Hardness	Cutting Speed Range, Feet per Minute	Feed Range, Inches per Minute
Low-carbon or Low-alloy Steel with 0.30 per cent carbon or less in following series: 10xx, 11xx, 13xx, 40xx, 86xx	1/4 to 3 3 to 6 6 to 9 9 to 15	120 to 220 120 to 220 120 to 220 120 to 220	60 to 120 60 to 80 45 to 80 40 to 60	5 to 8 4 to 7 3 to 5 2 to 4
Medium-carbon or Medium-alloy Steel with 0.30 to 0.50 per cent carbon, all series except 52xxx, 48xx, 33xx, 25xx, 9xxx	1/4 to 3 3 to 6 6 to 9 9 to 15	160 to 240 160 to 240 160 to 240 160 to 240	60 to 110 50 to 80 45 to 70 35 to 60	4 to 7 3 to 5 2 to 4 1 to 2 1/2
High-carbon or High-alloy Steel with 0.50 per cent carbon or over, including carbon and high-speed tool steels 52xxx, 48xx, 33xx, 25xx, 9xxx	1/4 to 3 3 to 6 6 to 9 9 to 15	200 to 300 200 to 300 200 to 300 200 to 300	30 to 60 30 to 40 20 to 40 15 to 30	1 to 3 3/4 to 2 1/2 3/4 to 2 1/2 to 1
Aluminum	All Sizes	90 to 130	2000 to 4000	50 to 100
Copper	All Sizes	55 to 85	1500 to 3000	30 to 60
Stainless Steel 3xx series .... 4xx series	 All Sizes All Sizes	 165 to 300 190 to 240	 20 to 60 40 to 60	 1 to 4 2 to 4
Brass	All Sizes	60 to 80	1100 to 2000	30 to 60
Cast Iron	All Sizes	170 to 220	40 to 60	4 to 6

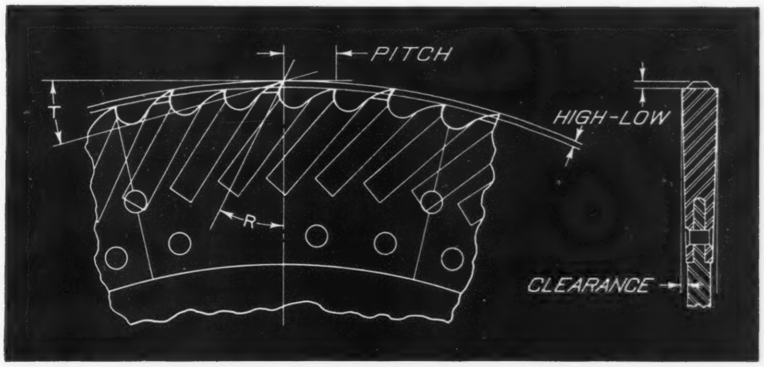

Fig. 2. Diagram illustrating the tooth rake angle and the top clearance angle on the teeth of circular saws

The teeth of saws generally used in circular sawing are ground alternately high and low, with the high tooth chamfered on both sides and the low tooth not chamfered. A saw ground in this way is shown in Figs. 2 and 3. The effect of this tooth grinding method is to produce single and double chips alternately. A high-low relationship of 0.006 to 0.010 inch is generally recommended for solid high-speed steel circular saw blades, while a relationship of 0.010 to 0.020 inch is used on segmental type blades. While most chips are self-clearing, a chip remover is recommended to dislodge clinging chips from the teeth.

In circular sawing, it is necessary to clamp the work securely while actual cutting is being done. An important point to remember in mounting a saw blade on the spindle is to remove the backlash in the driving pins by holding the blade

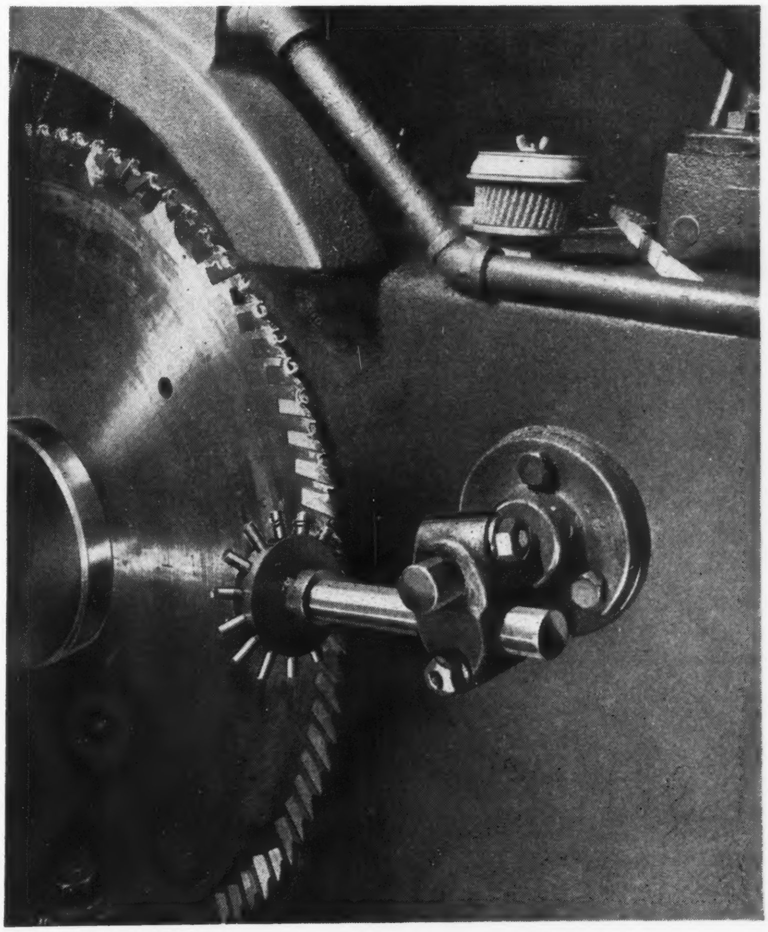

Fig. 3. Teeth of circular saws are generally ground alternately high and low, with the high tooth chamfered, so that single and double chips are produced

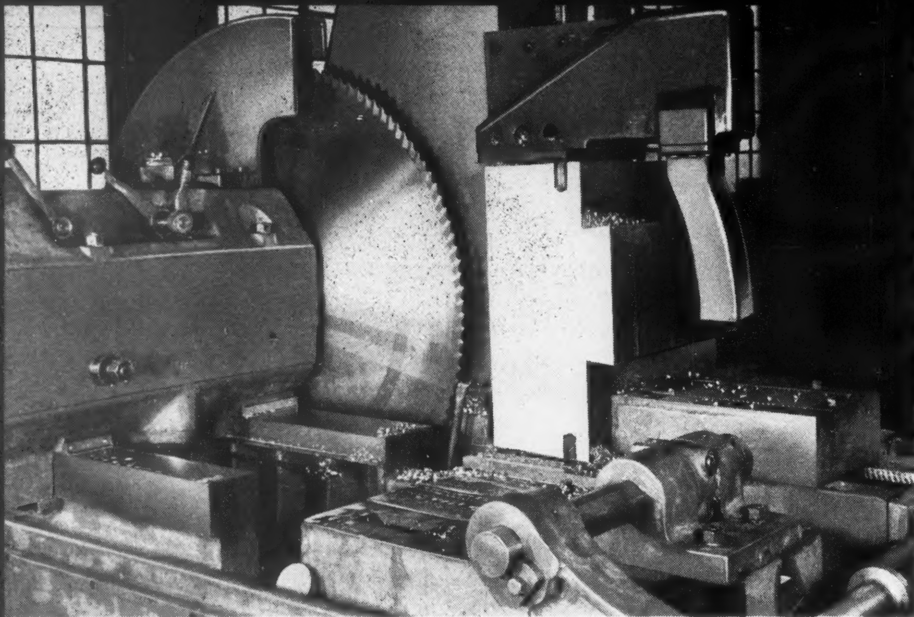

Fig. 4. Cutting through a large die-block measuring 12 by 24 inches in cross-section. The time required for this operation was twenty-four minutes

against the pins in the opposite direction to the rotation of the blade.

A coolant is recommended in sawing all ferrous and non-ferrous metals with the exception of cast iron and magnesium. For maximum saw blade performance, a good soluble oil, in the proportion of one part of oil to three parts of water, or a good cutting oil will be found satisfactory.

Circular sawing machines are available to meet varied conditions. There are both manually and automatically operated types. Generally, the stock is cut singly, although multiple set-ups are advantageous in certain instances. The heading illustration shows a manually operated machine engaged in cutting through a number of bars at one time in the Syracuse, N. Y., plant of the Crucible Steel Co. Fig. 4 shows an operation on a large die-block measuring 12 by 24 inches in cross-section. The cutting time for this operation was twenty-four minutes. On manually operated machines, the loading of the stock and the operation of the clamp and feed controls are all effected by hand. On automatic machines, all of these steps can be effected automatically or some of them can be performed manually.

Transfer type machines have been built for cutting off bars to a precise length. In such machines, the work is automatically fed to a stop and cut off to the required length, after which the cut-off piece is transferred to a second station for accurate machining of the two ends. The double-end operation is performed at the same time that a subsequent piece is being cut off, thus effecting a saving in time and production costs. Circular sawing, in combination with other secondary operations such as chamfering, milling, turning, etc., has been incorporated in transfer type machines. Fig. 5 shows a machine of this type cutting off 2-inch diameter solid stock to a length of 9 5/8 inches, center-drilling, and chamfering both ends. The time required for all cuts is twenty-two seconds per piece.

Fig. 5. Transfer type machine that not only cuts off bar stock, but center-drills, and chamfers both ends at a production rate of twenty-two seconds per piece

Cutting Costs Reduced by Tool Analysis and Research

By F. L. McKEEN
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Ford Motor Co., Dearborn, Mich.

A Continuous and Comprehensive Tool Analysis, Research, and Testing Program has Effected Improvements and Substantial Savings on Many Machining Operations at the Ford Motor Co.

THE Ford Motor Co. replaces machinery and tooling with improved equipment when the reductions in over-all cost resulting from such replacement is large enough to justify the investment. Purchases of plant equipment, machines, and perishable tools average about $100,000,000 per year. Efficient procurement of such a large volume of equipment requires a comprehensive tool analysis, research, and testing program. The Tool Analysis and Research Department at Ford is made up of men having extensive practical experience in shop practice, equipment, and tooling requirements. Each of these specialists is responsible for one group of tools; for example, one man handles carbide applications, while another investigates taps, reamers, and drills. They spend most of their time in the shop, studying tool performance with a view to effecting improvements and savings on various machining operations. This group cooperates with the Purchasing Engineering Department in writing specifications for machine and tool purchases, trying out new tools, and analyzing proposals.

Approximately 40,000 machine tools are used in the Ford plants. An inventory of these machines is maintained, so that equipment requirements for new or modified production processes can be determined. Records are also kept of machine "down time" for replacement and sharpening of tools, as well as tool consumption for various operations. In cases of high tool consumption or low production, a new tool or tool material may be substituted or the operation modified. For example, in one operation, the consumption of drills was reduced from 20,000

Tool No.: 12Z-1015-10

Tool Name: Reamer

Part Name: Connecting-Rod Cap	Part No.: 8BA-6210
Operation Name: Reaming	Operation No.: 5
Material: "EE" Steel	Brinell Hardness No.: 285-321
Machine: Advance	Speed: 558 surface feet per minute
Machine Condition: Fair	Feed: 0.0074 inch per minute
Department: 6583	Coolant: Soluble Oil

Test No.	1	2	3	4
Test Date	Oct. 1949	Oct. 1949	Oct. 1949	Oct. 1949
Supplier	A	B	C	D
Tool Material	HSS	HSS	HSS	HSS
Heat-Treatment	T-1	-	-	T-1
Number of Tools Tested	12	7	7	12
1. Unit Tool Price	$3.03	$3.07	$3.31	$3.33
2. Average Number of Holes per Grind	313	1347	1390	1035
3. Minutes per Grind	2 1/2	2 1/2	2 1/2	2 1/2
4. Cost per Grind	$0.15	$0.15	$0.15	$0.15
5. Grinds per Tool	8	8.6	8.2	5.9
6. Total Reconditioning Cost per Tool	$1.05	$1.29	$1.23	$0.89
7. Minutes Required to Set up Tool	6	6	6	6
8. Tool Set-up Cost	$0.30	$0.30	$0.30	$0.30
9. Total Set-up Cost	$2.40	$2.58	$2.46	$1.77
10. Total Pieces per Tool	2504	11584	11398	6107
11. Total Tool Cost	$6.48	$6.94	$7.00	$5.99
12. Tool Cost per Piece	$0.00258	$0.00059	$0.00061	$0.00098
13. Number of Tools Required for Monthly Production of 668,121 Pieces (1,336,242 Holes)	533.6	115.3	117.3	218.8
14. Yearly Savings over Present Tool	Current	$31,890.56	$31,639.54	$25,765.40

Remarks: Govern Procurement According to Tests—Preference: (1) B, (2) C.

Fig. 1. Tool-cost analysis showing results of tests on four competitive reamers used in machining connecting-rod caps. Yearly savings with reamers from supplier B are substantial

to 10,000 per year by reducing the spindle speed, increasing the feed, and changing the web thickness of the drills.

Tests of competitive cutting tools follow a specified procedure, and are carried out in regular production on standard machines and workpieces. Test data is summarized on tool-cost analysis forms, such as shown in Figs. 1 and 2. It can be seen from Item 14 on reamer analysis form, Fig. 1, that substantial savings can be effected by substituting reamers from suppliers B, C, or D for those from supplier A in this high-production operation. On the other hand, the results shown in Fig. 2 prove that the currently used carbide tool bit from supplier A is the most economical.

Such tool-cost analysis forms are distributed to the departments concerned, including the Purchasing Engineering Department. Replenishing orders for perishable tools are based largely on the results of such tests. These results are made available to the suppliers, and discussed with them.

The procedure followed in testing gear-cutters

Tool No.: 9Z-2469-6

Tool Name: Tungsten Carbide Tool Bit

Part Name: Motor Cylinder Sleeve

Part No.: 59A-6055-A

Operation Name: Rough-Bore Cylinder Sleeve

Operation No.: 3

Material: Cast Iron Grade A

Brinell Hardness No.: 179-228

Machine: Bullard

Speed: 264 surface feet per minute

Machine Condition: Good

Feed: 0.0282 inch per minute

Department: 6390

Coolant: Dry

Test No.	1	2	3
Test Date	Nov. 1949	Nov. 1949	Nov. 1949
Source	A	B	C
Tool Material	Carbide	Carbide	Carbide
Heat Treatment			
Number of Tools Tested	4	4	4
1. Unit Tool Price	$0.29	$0.29	$0.29
2. Average Number of Pieces per Grind	84	61	46
3. Minutes per Grind	0.3	0.3	0.3
4. Cost per Grind	$0.02	$0.02	$0.02
5. Grinds per Tool	5.9	5.3	4.5
6. Total Reconditioning Cost per Tool	$0.098	$0.086	$0.070
7. Minutes Required to Set up Tool	0.5	0.5	0.5
8. Tool Set-up Cost	$0.025	$0.025	$0.025
9. Total Set-up Cost	$1.48	$1.33	$1.13
10. Total Pieces Bored per Tool	496	323	208
11. Total Tool Cost	$1.87	$1.71	$1.49
12. Total Cost per Piece	$0.00376	$0.00529	$0.00716
13. Number of Tools Required for Monthly Production of 22,612 Pieces	45.5	70	108.7
14. Yearly Savings over Present Tool	Current	$415.38 Increase	$922.55 Increase

Remarks: Govern Procurement According to Tests—Preference: (1) A, (2) B.

Fig. 2. Tests of three different makes of tungsten-carbide tool bits for rough-boring cylinder sleeves proved that the currently used tools from supplier A were the most economical

and hobs consists of operating the tools on standard production machines for a predetermined number of regular work-pieces. The serial number stamped on the cutter by the vendor and the date that the cutter is placed on the machine are recorded, and the cutter is tagged. When removed from the machine, the cutter is carefully examined prior to sharpening, in order to determine accurately the amount of wear. After sharpening, the cutter is again examined to see how much stock has been removed from the cutter during the grinding operation. A comparison is then made between actual cutter wear and the amount of stock removed in grinding. When this has been done, the cutter is returned to the production machine and the cycle repeated.

As a result of many comprehensive tests consisting of numerous cycles on various cutters, it was recommended that, in order to improve cutter life and reduce production costs, all cutters should be inspected prior to sharpening, and the amount of stock to be removed from the cutter during sharpening should be specified. This controlled grinding technique was tried with cutters

Fig. 3. Amount ground from gear-shaper cutter during sharpening is carefully controlled. Total production obtained per cutter has been more than doubled by controlled grinding

used on a Fellows gear shaper for machining forged-steel main transmission drive-shafts. The cutters were operated at 464 strokes per minute (116 surface feet per minute), removing 0.080 inch of stock from the forging. Stock removed from each cutter during sharpening averaged about 0.010 inch, and the cutters were sharpened after machining ninety-two forgings. With this procedure, each cutter had an average total life of 1777 work-pieces.

With uncontrolled grinding, the average total production per cutter was only 800 work-pieces. Results of this test show conclusively that if the amount to be ground from dull cutters is specified, and only the specified amount is removed during sharpening, the production attained per cutter can be more than doubled.

Special cutter inspection fixtures and a Bausch & Lomb ten-power magnifier, as seen in the heading illustration, are employed to determine the amount of stock to be removed during sharpening. Grinding machines used for sharpening should be provided with feed controls that can be automatically pre-set, dial feeds, or dial indicating attachments (Fig. 3), so that stock removal can be accurately controlled.

Hob life has been more than doubled and machine "down time" for tool changes has been substantially reduced by the installation of automatic hob-shifting heads (Fig. 4) on the hobbing machines. These heads automatically shift the hobs to new cutting positions following each cycle. After each hob has been shifted the entire length of the cutting face, the automatic shifter reverses its direction. In this way, all hob teeth are worn an equal amount and manual control of hob shifting is eliminated. Initial cost of such automatic hob-shifting heads has been amortized in forty-nine working days.

In cases where manual hob shifting is still employed, more hob settings are specified over the

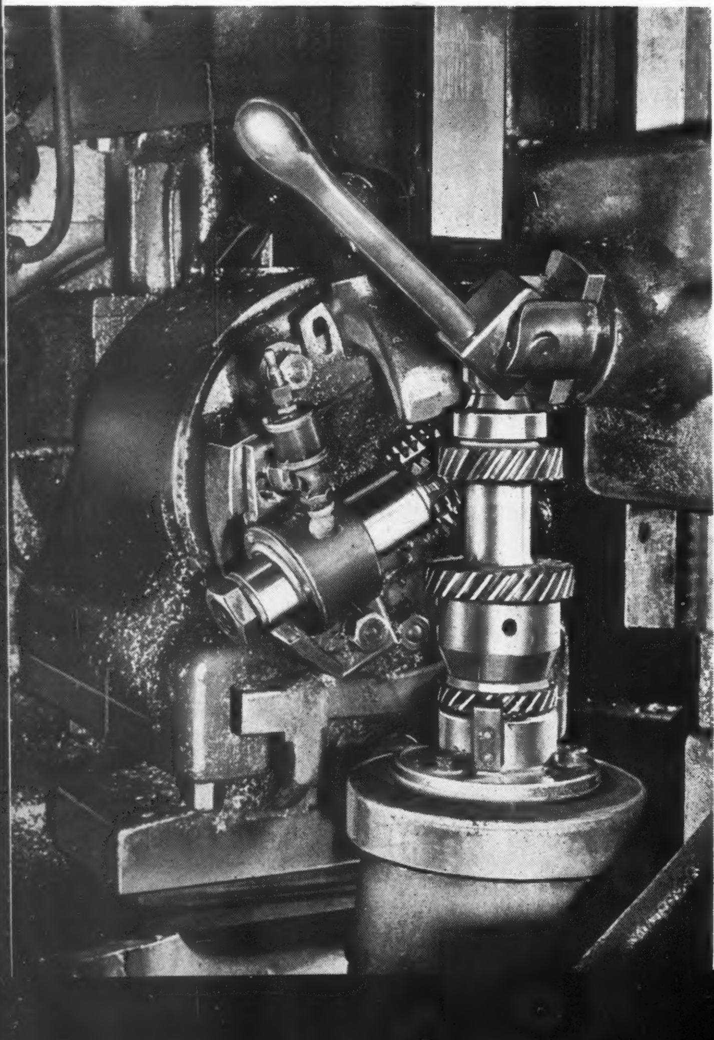


Fig. 4. Hob life has been more than doubled and machine "down time" for tool changes reduced by equipping the hobbing machines with automatic hob-shifting heads

BY TOOL ANALYSIS

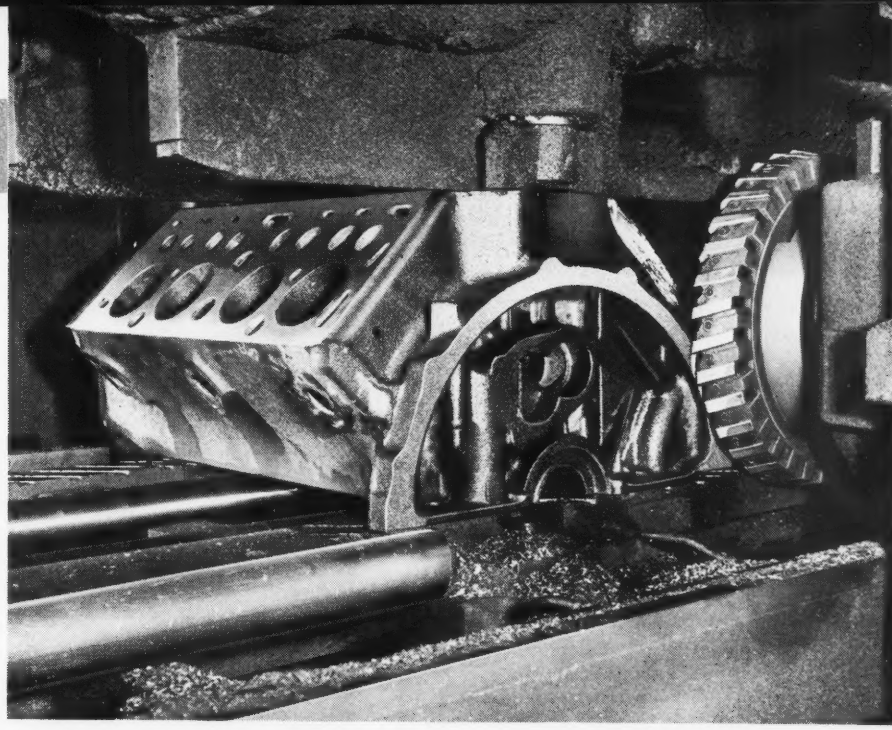


Fig. 5. Life of milling cutters employed to machine cast-iron cylinder blocks has been improved 312 per cent by increasing number of teeth and decreasing rake angles

length of the hob, with less gears cut per setting. For example, on a hob 3 1/4 inches long, six settings are specified, with thirty gears cut at each setting. Other factors that have contributed to lower tool costs are the use of longer hobs and hobs that are hardened but not ground.

Schedules have been set up for controlled grinding of most milling cutters. Previously, cutters were changed at the discretion of the operator, with no fixed schedule, while now the cutters are changed at the end of each specified run, regardless of the surface finish on the cutter teeth. Production has been increased, tool breakage has been reduced, and fewer tool changes are necessary. Record cards are maintained for cutters mounted on each spindle of every machine, showing the cutter serial number, number of pieces produced, amount of wear, and whether any teeth were chipped or broken.

Milling cutters being tested bear special tags and do not follow a predetermined grinding schedule. Often the design of such test cutters is modified to determine the most suitable cutting angles, and sometimes cutters with different numbers of teeth are tried out. In one case, the life of milling cutters employed to machine cast-iron V-8 engine cylinder blocks, as shown in Fig. 5, has been increased 312 per cent by modifying their design. These cutters are employed on a transfer type milling machine, and are rotated at 250 surface feet per minute, with a chip load of 0.015 inch per tooth. On the improved design cutters, the rake angles (positive) have been decreased from 15 to 5 degrees, and the number of teeth or blades has been increased from twenty-six to thirty-eight on 10-inch diameter cutters and from thirty-eight to forty-eight on 13-inch diameter cutters. With the previous type cutters, only 800 blocks could be milled before sharpening was necessary. Now, 2500 parts are machined between grinds. This results in an annual saving of $24,000, with an initial expenditure of less than $12,000 for twenty-nine new cutters.

Substantial savings have been made in machining push-rod holes in cast cylinder blocks by eliminating the cored hole in the casting and drilling the hole from the solid. With the cored-hole method, it was frequently necessary to ream the push-rod hole after drilling in order to attain the proper alignment. With the improved method, the hole is drilled in the solid casting with a carbide-tipped twist drill. Repair reaming has been reduced more than 50 per cent, and the complex job of coring the casting has been eliminated. Annual savings resulting from this change are over $150,000 a year.

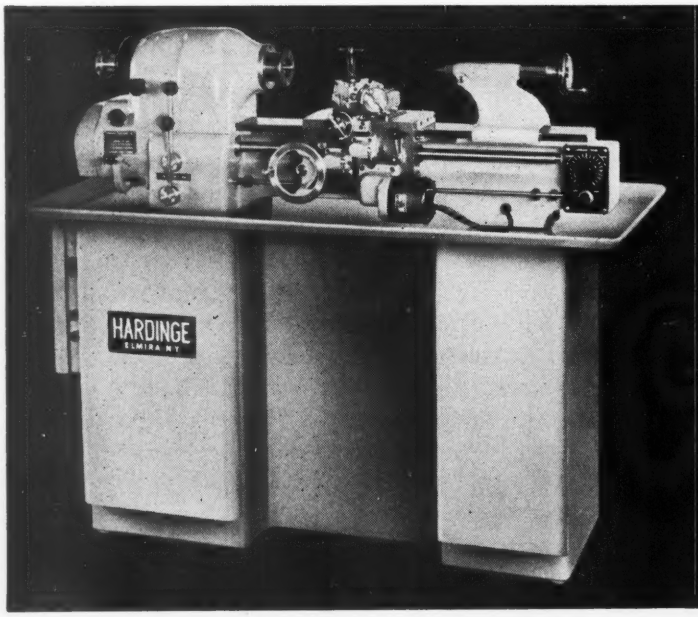
Cost-Cutting Equipment

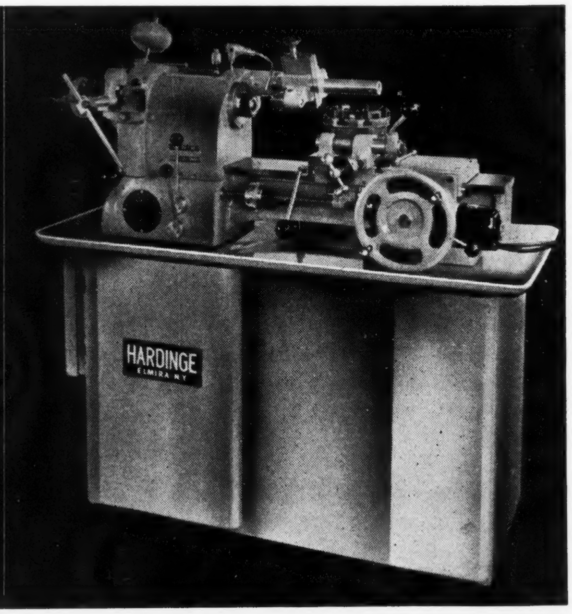
Hardinge Lathes and Milling Machine for Tool-Room and Production Work

Hardinge Brothers, Inc., Elmira, N. Y., will have three machines (matched for precision work) in operation in the tool-room section of their booth. These machines include the new Model HL tool-room lathe shown below at the left, the Model UM universal milling machine shown at the right, and a Model DV59 high-speed precision lathe (not shown) which has spindle speeds up to 4000 R.P.M. The lathe has a swing of 10 inches, 1-inch collet capacity, speeds up to 3200 R.P.M., precision gear-box for threading only, and independent electric feed for carriage and cross-slide. The milling machine has 14-inch longitudinal, 13 1/4-inch vertical, and 5 1/2-inch transverse travel. Spindle speeds range up to 1850 R.P.M. In the production section of the booth will be exhibited the new Hardinge Model HCT chucking machine shown below at the right. This machine is equipped with threading head. It has a step chuck of 6-inch capacity, an eight-position turret, and spindle speeds up to 3000 R.P.M. Other machines exhibited in the production section (not illustrated) include the Model HC chucking machine; Model AC59 second-operation machine set up for high-speed precision finishing of small parts; Model DSM59 high-speed precision second-operation machine engaged in production threading; and Model AQ59 hand screw machine performing high-speed precision bar work. Booth No. 835.

New Norton Abrasive Products

The Norton Co., 1 New Bond St., Worcester 6, Mass., will feature an unusual tool-grinding operation, using a 32 Alundum wheel for grinding a 16- by 2-inch face milling cutter. This exhibit will demonstrate the faster, cooler cutting action of one of the company's newest abrasive products. The newly developed Norton "reinforced hub" cut-off and sanding type wheels will also be shown in operation on portable grinders. When used on rough work, these wheels have proved to be fast cutting and unusually durable. The cut-off wheel is used on dry operations for removing sprues, gates, and risers from non-ferrous castings, and for light snagging, cleaning cast-iron gear teeth, and track weld slotting. The "raised hub" reinforced-hub wheel for sander type portable grinders is adapted for grinding down welds, smoothing castings, reaching into corners, nicking large gates and risers on castings to facilitate breaking them off, deburring and breaking corners, and removing rust and scale. Also included in the exhibit will be the recently announced Norton ceramic surface plate, Norbide boron carbide dressing sticks and parts for wear-resistant applications, and a display of grinding wheels. Booth Nos. 409, 411, 413, and 415.

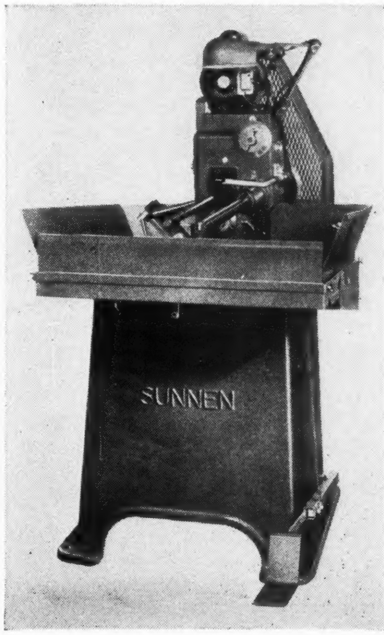




on Review at Philadelphia

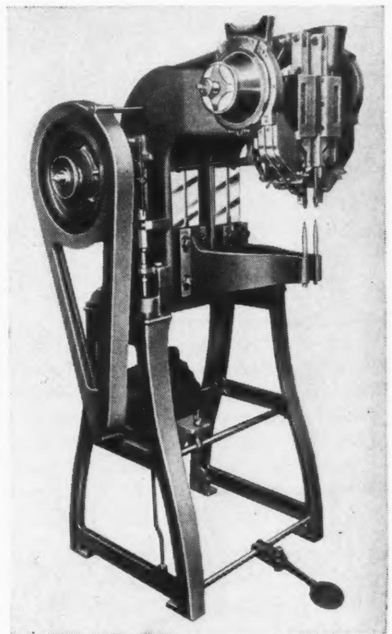
Sunnen Floor Type Wet Honing Machine

New Model MBB wet honing machine incorporating several improvements in design and in operating features, to be demonstrated by Sunnen Products Co., 7910 Manchester Ave., St. Louis 17, Mo. Longer life at higher production speeds, reduced maintenance costs, smoother operation, ability to handle heavier loads, and greater flexibility are advantages claimed. The machine has four speeds, uses standard Sunnen honing mandrels for sizing and finishing holes from 0.120 inch to 2.625 inches in diameter, and is recommended for use on all metals, as well as ceramics and glass. A self-energizing brake stops the spindle instantly, and thus serves to speed up loading and unloading of the work. A 1/2-H.P. motor with resilient base is employed to eliminate vibration. Booth No. 531.



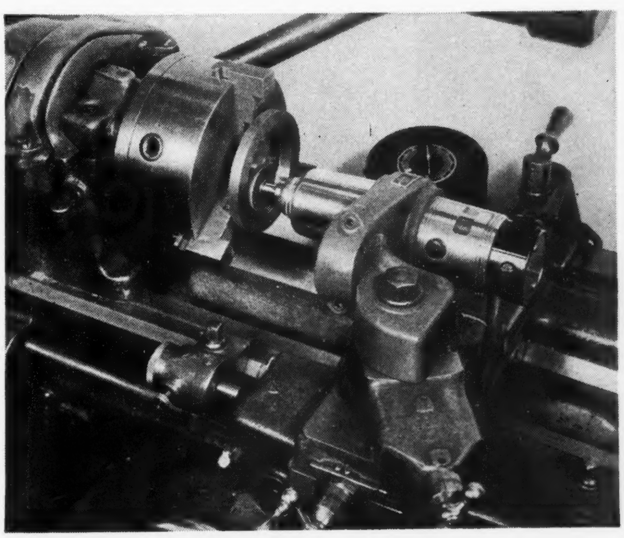
Double Rivet-Setter

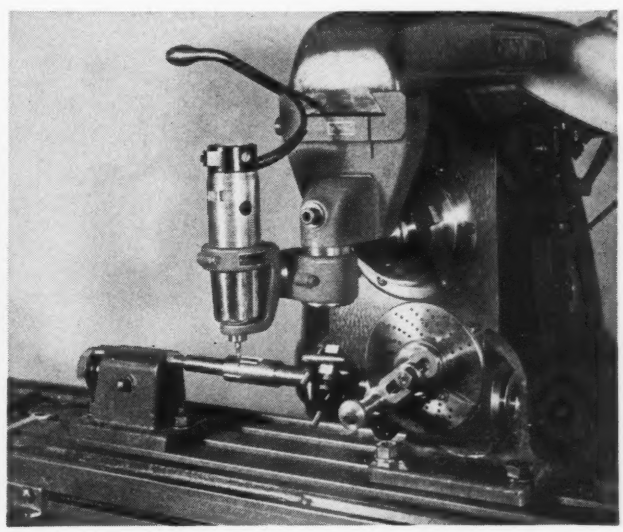
Double rivet-setter with 14-inch throat which will set 9/64-inch steel tubular rivets, including lengths up to 5/8 inch, to be exhibited by the Chicago Rivet & Machine Co., 9600 W. Jackson Blvd., Bellwood, Ill. The standard Model 214 can be adjusted for any center distance from 3/8 inch to 7 inches. Special models are available with a center distance adjustment range of from 3/8 inch to 15 inches. Booth No. 1123.

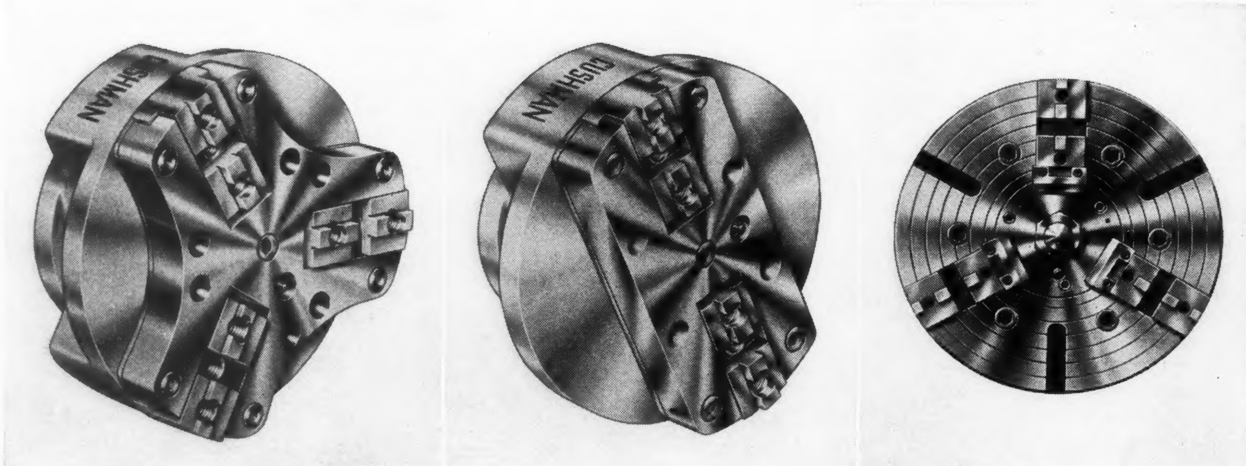


"Grinder-Millers" Exhibited by Precise Products Co.

(Left) "Grinder-Miller" mounted as a motorized precision quill in a regular lathe for precision grinding operation. (Right) "Grinder-Miller" used on milling machine for vertical end milling work. These "Grinder-Miller" units will be included in the new line of high-speed portable electric tools and mounts to be exhibited bv the Precise Products Co., 1338 Clark St., Racine, Wis. The units have 1/4-H.P. motors, and are designed for a spindle speed range of 20,000 to 45,000 R.P.M. Applications include internal, external, cylindrical, and form grinding, precision milling with high-speed steel or tungsten "Midget Mills," sawing, routing, slotting, small-diameter drilling, micro-finishing, and polishing. Booth No. 441.





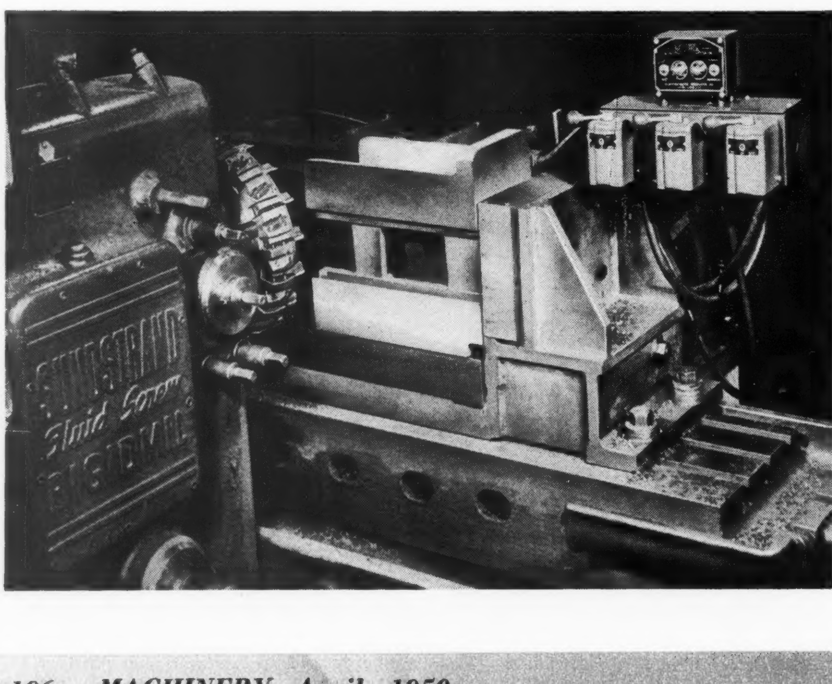


Aluminum-Body and Compensating Chucks

The Cushman Chuck Co., Hartford 2, Conn., will have on exhibition the two new aluminum-body chucks shown at the left in the illustration; an operating model of a new high-speed aluminum-body air cylinder for use with power chucks, designed to operate at spindle speeds up to 6000 R.P.M.; a new power wrench, together with an improved design of scroll chuck; and a three-jaw compensating type power chuck, shown in the view to the right. This new equipment, designed to speed up chucking and releasing of work and to permit higher machining speeds, will be shown in operation at Booth No. 866.

Sundstrand Power-Grip Magnetic Fixture

Power-grip magnetic fixture that can be quickly set up to hold the same motor frame part for eight different milling cuts. This equipment will be demonstrated in the Magnetic Products Co. Division exhibit of the Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill., together with power-grip magnetic chucks and work-holding setups for keyway milling, die-block milling, form-grinding, and diversified toolroom work. The Pneumatic Division of the exhibit will show single- and double-pad portable sanders for sanding, rubbing, or polishing metal, wood, and plastics. New Sundstrand pumps, valves, fluid motors, and tanks that conform to J.I.C. standards will be exhibited in the Hydraulic Division. All three exhibits will be in Booth No. 907.

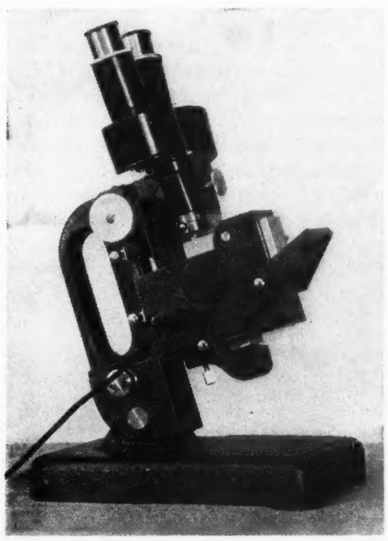


Pratt & Whitney Comparator

The Model F "Air-O-Limit" comparator illustrated is one of the many new developments of Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., to be exhibited at Booth 815, where a complete line of precision cutting tools and gages will be demonstrated. The comparator has a wide range of applications, including the checking of internal and external diameters, straightness, width, length, taper, and out-of-roundness. The exhibit will also include thread checking and measuring gages of interesting design. "Kellerflex" flexible-shaft machines, Keller burrs, the new "Di-Bur," and the "Diaform" wheel-dressing attachment will be demonstrated at Booth No. 632.

Leitz Comparison Microscope for Surface Finish

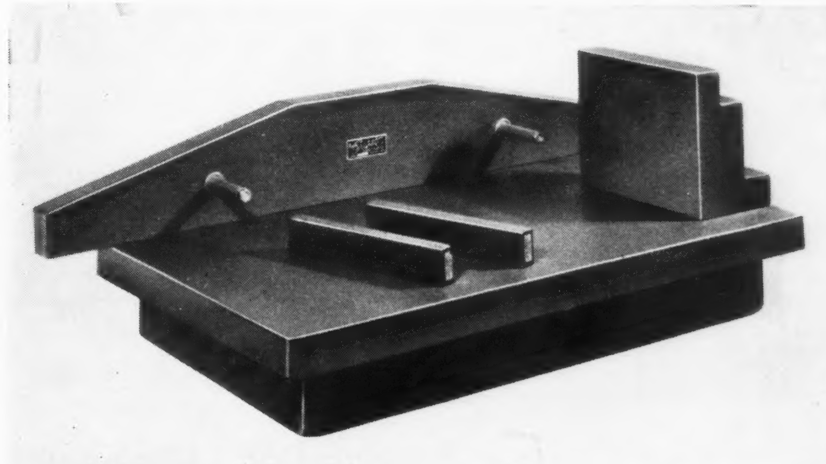
Leitz comparison microscope for examining or comparing machined surfaces for quality of finish. This instrument is included in a group of measuring and testing instruments exhibited by the George Scherr Co., Inc., 202 Lafayette St., New York 12, N. Y. With this instrument, a sample piece or master having the approved finish is placed on one stage, while the piece to be examined is placed under the lower objective lens. The images of both master and work to be examined appear alongside each other, making possible accurate comparison. The microscope produces a three-dimensional



image, and is provided with a special transformer for furnishing light that brings out the grinding marks of the finish. Booth No. 209.

Oakite Cleaning Compounds

Recent additions to the line of metal cleaning materials which are to be exhibited by Oakite Products, Inc., 26 Thames St., New York 6, N. Y., include an acid type cleaner and surface conditioner for ferrous metals and aluminum, known as Oakite compound No. 33; a material that forms a dense foam-blanket on pickling solutions to prevent the escape of acid fumes, known as Oakite composition No. 38; and other new compounds. Booth No. 565.

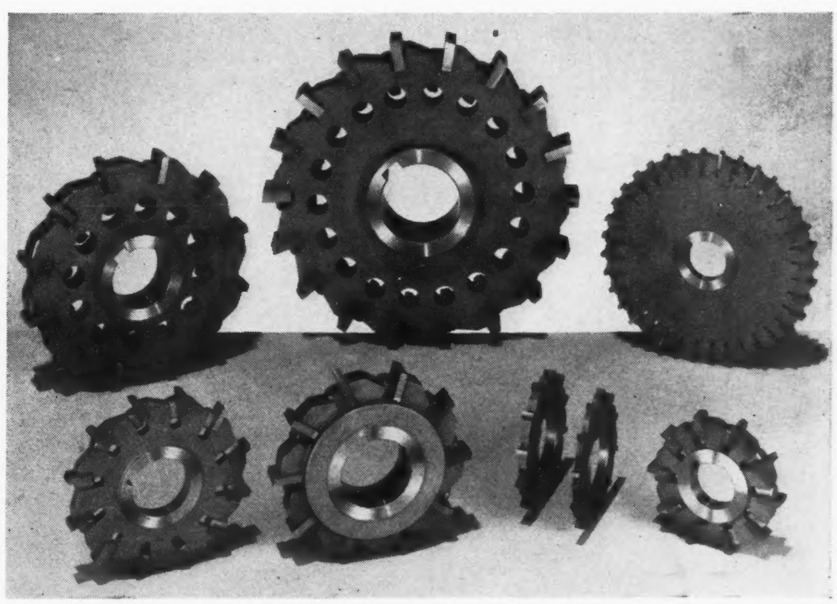


Rahn Granite Surface Plates, Angles, Parallels, and Straightedges

Angle-plate, parallels, straightedge, and surface plate included in a complete line of precision inspection equipment made of black granite to be exhibited by the Rahn Granite Surface Plate Co., 1149 Platt Circle, Dayton 7, Ohio. The accuracy of these products, claimed to be held to tolerances of 0.00005 inch, is obtained by especially developed hand lapping methods. Booth No. 718.

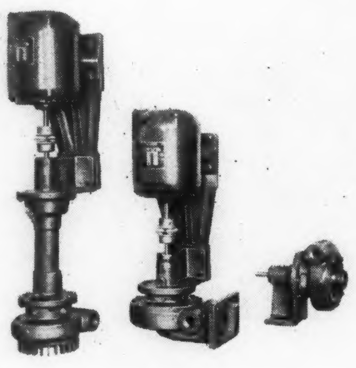
Lovejoy New Type Milling Cutters

Radically different type of inserted-tooth milling cutters for slotting and side milling announced by the Lovejoy Tool Co., Inc., Springfield, Vt. These new cutters, designated Type S, have blades which are essentially standard carbide blanks held in the cutter bodies by a simple taper wedge. Maintenance costs are said to be reduced because of the ease with which the blades can be set, reground, and replaced. Diamond wheels only are necessary for sharpening the blades, since no steel need be ground. The small size of the blades and wedges permits a comparatively large number of blades to be inserted in the body, even on small cutters. One cutter body can be fitted with any



grade of carbide blade for cutting various types of metal. These cutters are available in widths from 3/16 to 1 inch and in diameters from 3 to 8 inches. Booth No. 646.

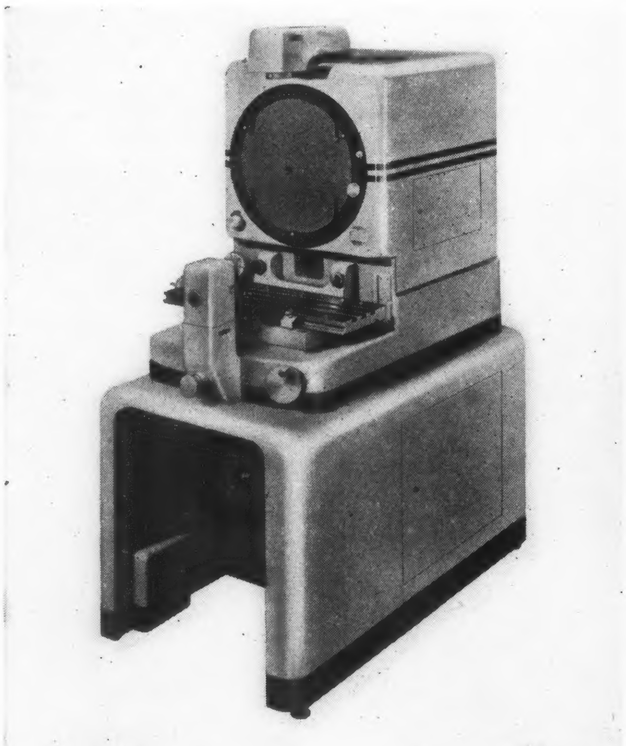
Pioneer Coolant Pumps



A full line of centrifugal coolant pumps, all conforming to J.I.C. standards to permit the use of any NEMA motor, is to be shown by the Pioneer Pump & Mfg. Co., 19679 John R. St., Detroit 3, Mich. The assembly at the left is a submersible type, designed for installation inside the coolant tank and normally resting directly on the bottom of the tank. Brackets and flanges are available to facilitate mounting on the edge, side, or top of the tank. The assembly in the center is built to be mounted on the side of a coolant tank or machine pedestal for a close-coupled installation. No auxiliary inlet piping is required. The assembly at the right is made for various types of connections to the driving unit, and can be operated in a horizontal position, as shown, or it can be mounted vertically if desired. Booth No. 532.

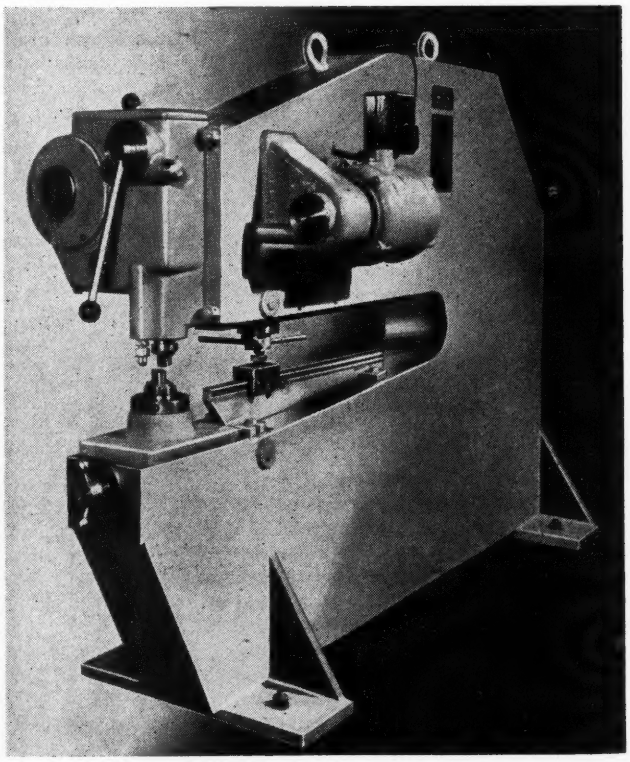
Kodak Contour Projector of Improved Design

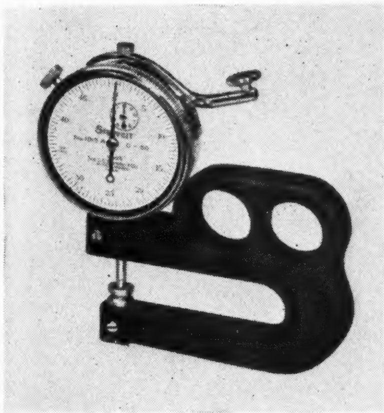
New Model 2 contour projector having greater working space for efficient staging, which will be demonstrated by the Eastman Kodak Co., Rochester 4, N. Y. This optical comparator has 14 3/4 inches of working space between the lamp house and lens, regardless of magnification. The work table has been enlarged to 20 inches in length, and the vertical travel has been increased from 2 to 4 inches. Eight inches of space is provided between the object under inspection and the first lens of the projection system, while additional working space has been gained by relocating the lamp house. The 10x, 20x, 31.25x, 50x, 62.5x, and 100x magnification lenses available give distortion-free images of exact magnification over the entire 14-inch screen. Booth No. 816.



Pullmax "Major" Sheet and Plate Cutting Machine

"Major" sheet-steel and plate cutting machine to be exhibited by the American Pullmax Co., Inc., 2627 North Western Ave., Chicago 47, Ill. This machine will cut the finest gage sheet steel, as well as steel plate of any thickness up to 11/32 inch. The upper cutting tool, which reciprocates at a very high speed, makes a clean cut that, in most cases, requires no further finishing. The machine will do straight cutting, inside or outside circle cutting, inside or outside square cutting, inside or outside design cutting, slot cutting, beading, folding, flanging, and nibbling. The machine can also be employed effectively for cutting stainless steel as well as all types of non-ferrous sheet metal, wire mesh, and plastic sheets. Booth No. 959.





Starrett Dial Indicator

Portable dial hand gage, designed for the rapid, accurate gaging of the thickness of parts and materials such as sheet metal, rubber, textiles, paper, plywood, leather, cardboard, etc. This gage will be included among the many new dial indicators, gages, calipers, and micrometers to be exhibited by the L. S. Starrett Co., Athol, Mass. It is available in two thickness capacities—No. 1015-A with graduations of 0.0005 inch and a range of 0 to 1/2 inch; and No. 1015-B with 0.001-inch graduations and a range of 0 to 1 inch. Both gages have throat capacities of 2 1/2 inches. Booth No. 322.

"Titan" Ring Thread Gage

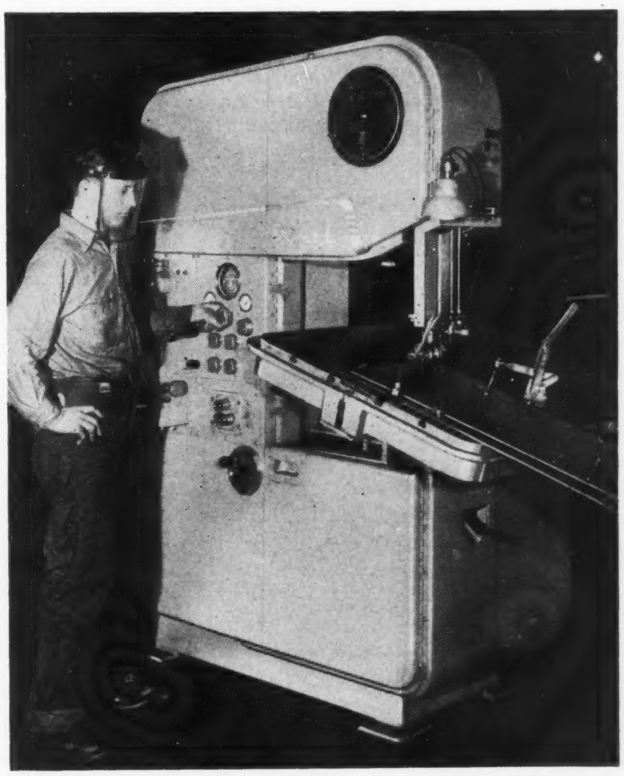
The Republic Gage Co., Detroit 21, Mich., has just added to its line a titanium solid ring thread gage that is said to show no measurable wear after months of continuous service. The ring, as shown in the illustration, is of the insert type with knurled aluminum collar. The material in the ring is light weight but not fragile. It has self-lubricating properties. Booth No. 947.

DoAll "Cool" Surface Grinder

Super precision surface grinder equipped to demonstrate "cool grinding," developed to keep the work and wheel cool without interfering with a full view of the work and without requiring the use of conventional coolant tanks and pumps. These advantages are made possible by injecting coolant through the grinding wheel, utilizing the centrifugal pumping action of the rotating wheel. This and other developments will be shown by DoAll Co., Des Plaines, Ill., in Booths 121 and 125.

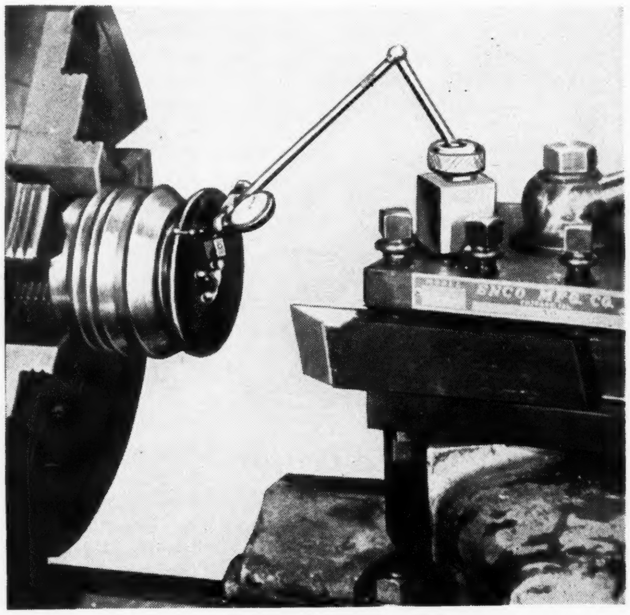
DoAll Contour-Matic Band Saw

New "Contour-matic" band saw with complete hydraulic control, to be displayed in operation by the DoAll Co., Des Plaines, Ill., demonstrating "line milling" and "line grinding"—two recently developed methods for machining hard, abrasive, and tough materials. These machining processes employing new types of band cutting tools and the new band machine designed for high-speed cutting of a variety of materials will be demonstrated in Booths 121 and 125.



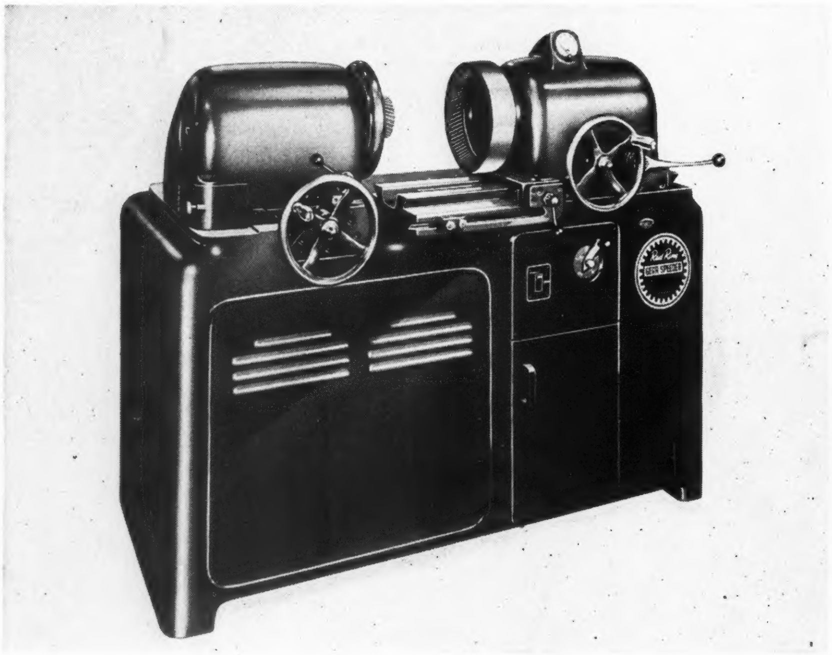
Davis Car-Wheel Boring Tools

Flange and shank type car-wheel boring tools of new four-cutter design to be included in the complete tooling display of the Davis Boring Tool Division of the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. These tools are provided with cemented-carbide cutters, and can be used for rough-boring at high feeding rates on modern boring machines. The four-cutter roughing blocks and two-bladed finishing blocks are shown in the illustration. Other new products in this exhibit include super micrometer stud boring tools; carbide planer and vertical boring mill tools; and inserted-blade adjustable reamers. Booth No. 230.



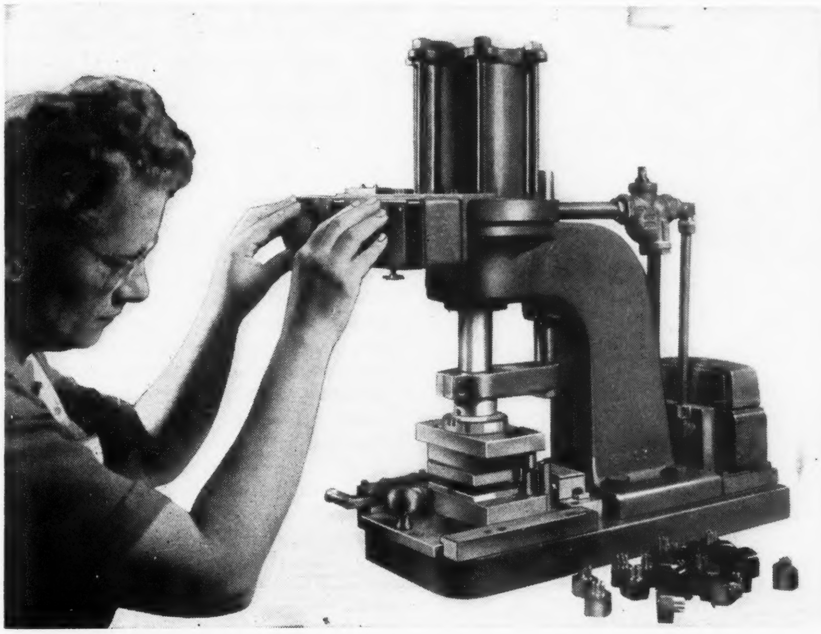
Miti-Mite Magnetic Indicator Base

The Enco Mfg. Co., 4522-24 W. Fullerton Ave., Chicago 39, Ill., is presenting a new "Miti-Mite" group of magnetic-base indicator holders and magnetic-base "Handi-Lites." These two products have a wide variety of uses in every shop. The V-block base construction allows them to be mounted on both flat or convex surfaces. The 50-pound pull of the magnet allows it to be employed in many instances as a sweep indicator. It is especially suited for use on a lathe, planer, shaper, or grinder, or for any application where a fixed indicator is required. Enco turret toolposts, hex-turrets, and tailstock turrets will also be on display. Booth No. 303.



Gear Testing Machines

The exhibit of the National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich., will include the latest equipment for checking gears dimensionally as well as for the sound-testing of gears. A new sound tester is shown in the illustration. This machine has been built for both external and internal gears, and is especially suitable for planetary gear assemblies, such as those used in automatic transmissions. With it, gear sets that are objectionably noisy in operation can be detected and corrected before assembly. The machine is built in two sizes, one for gears up to 14 inches in diameter and the other for gears up to 24 inches in diameter. Tests are run at four different speeds in either direction with or without gear loading. The machine can be equipped for air clamping to expedite loading and unloading. Recently designed broaches, for producing precision high-speed internal involute gears, will also be shown. Booth No. 601.



Hannifin Air-Operated "Han-D-Press" Adapted for Rapid Press-Fit Assembling

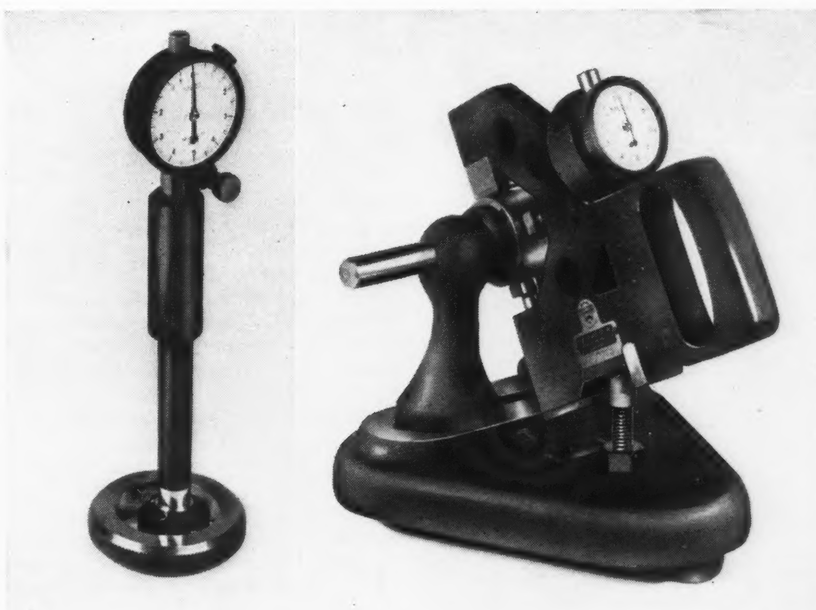
In addition to a number of new and improved air control valves, the Hannifin Corporation, 1109 S. Kilbourn Ave., Chicago 24, Ill., will have on display for the first time its 1/2-ton, small size, air-operated press. The new Model M-1, as it is called, is the most recent addition to the company's line of presses, which are made in air-operated types with capacities up to 18 tons and in hydraulic types from 5 to 300 tons. The 1/2-ton press is fast operating and semi-automatic. It is especially applicable to press fit assembly operations, such as required in the manufacture of electric motors, small tools, and radio and bearing parts. This new press is also suitable for performing light stamping, marking, and die cutting operations. Booth No. 215.

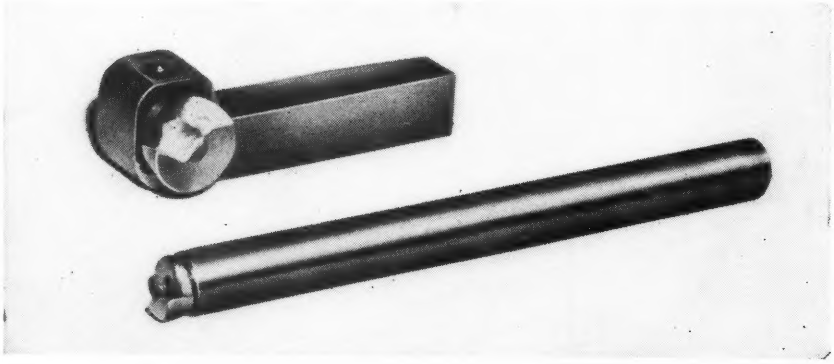
"Dializer" Snap Gage Attachment

"Dializer" attachment applied to adjustable-limit snap gage to convert it to a dial snap gage. After being installed, the "Dializer" can be easily adjusted by means of a knurled nut. It can be clamped in the correct position by the locking mechanism originally used for one of the gaging pins. The converted gage has the same range of adjustment as the original gage. The

Nilco Dial Type Bore and Snap Gages

The large dial bore gage shown at the left and the dial snap gage shown at the right are included in the exhibit of the Nilsson Gage Co., Inc., 2A Lake St., Poughkeepsie, N. Y. The Nilco line of dial bore gages covers a range of from 5/8 inch to 12 inches. These gages are regularly furnished with 0.0001 inch graduations. The same indicator can be used with the complete range of extensions. Gages employ three-point alignment and two-point gaging and can be set by gage-blocks or master rings. The dial snap gage has a framework machined from rolled magnesium, and is designed to obtain maximum rigidity and to minimize dimensional changes caused by variations in temperature. Another feature of this gage is a vernier screw which permits 1/4-inch adjustments of gaging pin or anvil. Booth No. 1151.

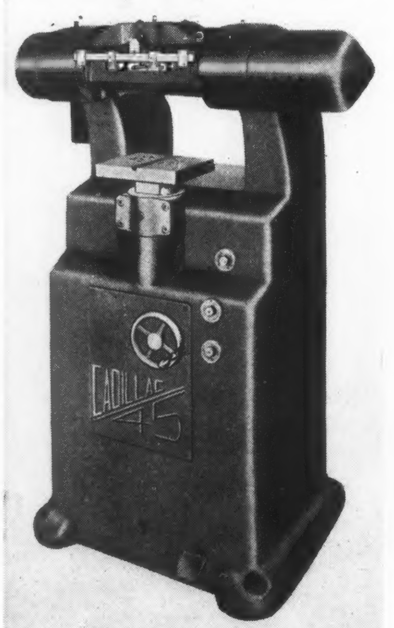


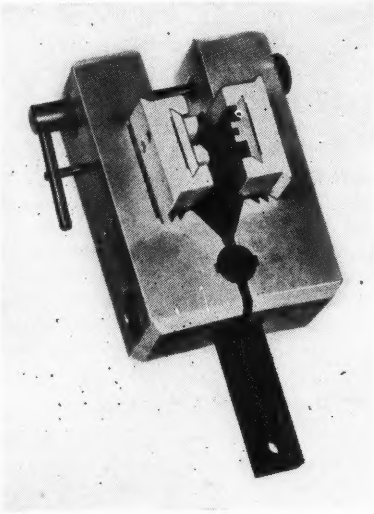


"Dializer" is now being manufactured by the Standard Gage Co., Inc., Poughkeepsie, N. Y., for American Gage Design adjustable-limit snap gages of any model with frames Nos. 1 to 6, inclusive (checking range up to 3 inches). Can be furnished with dials reading to either 0.0001 or 0.001 inch. Accuracy is assured by the double reed which supports the spindle. Booth No. 932.

Cadillac Hydraulic Marking Machine

Hydraulic marking machine to be displayed in operation by the Cadillac Stamp Co., 2136 Riopelle, Detroit 7, Mich. This Cadillac 45 machine is adapted for marking flat, round, and irregular-shaped pieces at operating speeds up to 110 one-inch strokes per minute, with pressures up to 12,000 pounds. The full range of marking depth can be readily controlled. Other Cadillac exhibits will include the new "Automark" electric metal marking typewriter and the "Automark" marking machine. Booth No. 753.





Sunnen External Hone

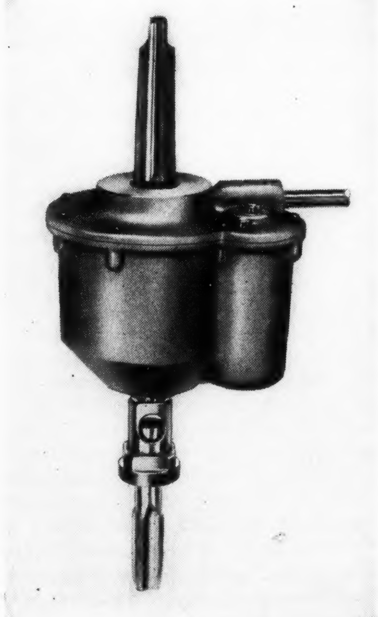
Precision external hone developed by the Sunnen Products Co., 7910 Manchester, St. Louis 17, Mo., for accurate and rapid finishing of cylindrical parts to size. Adapted for production work, as well as for use in tool-rooms and salvage and maintenance departments. Will produce exceptionally fine finish on pistons, pins, shafts, and similar parts ranging from 1/8 inch to 2 3/4 inches in diameter. Parts to be sized can be driven by Sunnen wet honing machines or by lathes, drill presses, and other power-operated machines. Besides a complete line of external hones, the company will also exhibit a new portable honing tool for accurate finishing of holes ranging from 3/16 to 1 inch in diameter. Booth No. 531.

J & S Kola Circular Turning Tools

Kola external and internal circular cutting tools to be demonstrated by the J & S Tool Co., Inc., 477 Main St., East Orange, N. J. The external tool is intended primarily for turning, facing, and forming operations, and can be used for butt-facing, threading, grooving, chamfering, and cutting off. The internal tool is designed especially for boring, internal facing, and turning. It can also be used for forming, grooving, butt-facing, chamfering, and threading. Different cutters can be used in same shank. Dull cutters can be quickly changed for reground ones without removing the shank from the machine. Jigs enable the cutting edge to be relocated in exactly the same position as that of the cutter removed for sharpening. Booth No. 954.

New Tap Head for Large Hole Tapping

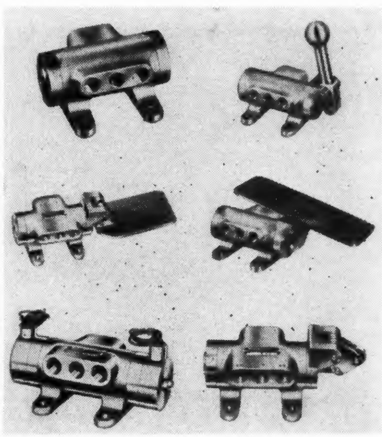
Basically new "Tap King" high-speed tapping head developed by Procunier Safety Chuck Co., Department 21, 18 S. Clinton, Chicago 6, Ill., to cut costs on large hole tapping work and to increase tap life, maintain an accurate, uniform thread depth, and reduce operator fatigue. The unit has a capacity of 3/8 to 1 inch in steel and 1 1/8 inches in softer materials. It is available with a No. 3, 4, or 5 Morse taper



shank. Also made in a cover clamping model for extra rigidity. Other products to be shown include universal foot-operated tapping machines, quick-change chucks and collets, friction tap-holders, "Tru-Grip" tap chucks, and accessories. Booth No. 611.

Modernair Control Valves

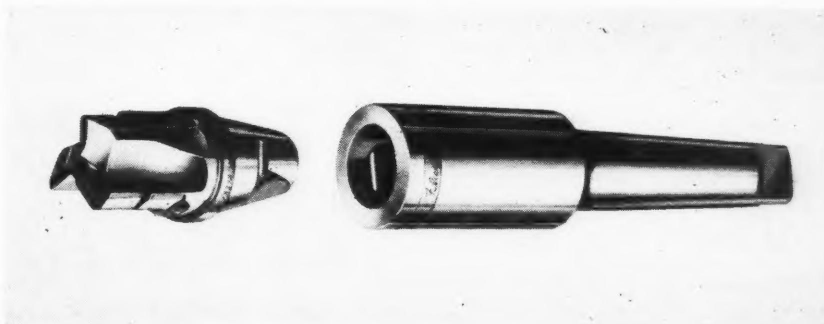
Control valves and cylinders for air, water, and low-pressure hydraulic service to be exhibited by the Modernair Corporation, 4222 Hollis St., Oakland 8, Calif. The exhibit will also include air-operated machine tool feeding units;



non-rotating cylinders for air and hydraulic circuits; air presses; air-collet closing fixtures; air-operated hydraulic pumping units; and quick exhausting valves. Of particular interest is the newly expanded line of CV series valves which offers 280 distinct valve combinations, using a basic body casting in 3/8- and 3/4-inch pipe sizes. Booth No. 957.

Allegheny-Ludlum Hot-Work Die Steel

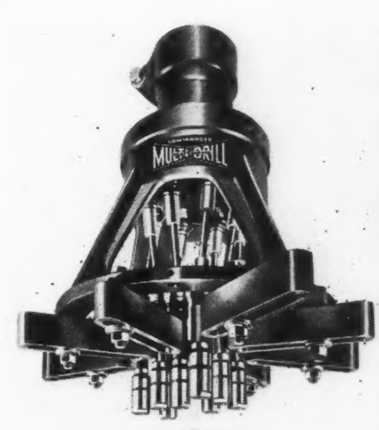
One of the newest hot-work die steels, known as B-47, will be a feature of the exhibit of the Allegheny Ludlum Steel Corporation, Room 2036, Henry W. Oliver Bldg., Pittsburgh 22, Pa. Dies made from this new steel will be on display. Tool steels and Carmet sintered-carbide alloys will also be shown. The tool steels exhibited will include high-speed, cold-work, hot-work, shock-resisting, and carbon steels, available in bars, forgings, flat rolled (strip, coils,



and blanks) and cast-to-shape forms, composite drill rod, and tool bits. The Carmet exhibit will feature carbide dies used in blanking, forming, and drawing. Booth No. 618.

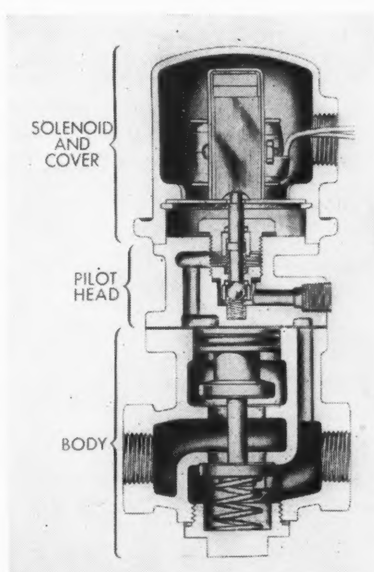
Falcon Counterbores with Interchangeable Pilots

Falcon "T-I-Drive" counterbore to be introduced by the Falcon Tool Co., 12502 Greiner, Detroit 5, Mich. The "T-I-Drive" (taper interchangeable) of this counterbore with interchangeable pilots can be adapted to almost any shank type tools for drilling, boring, reaming, milling, and similar operations. The taper is accurately ground and the cutting portion of the tool is also ground true to insure a finished tool that is concentric with the shank. A two-point positive drive equalizes cutting load when cutter is inserted in holder. Tools can be quickly changed in holder for second operation; a slight turn to the right locks the tool in place, and a slight turn to the left releases it. Booth No. 560.



Commander "Multi-Drill"

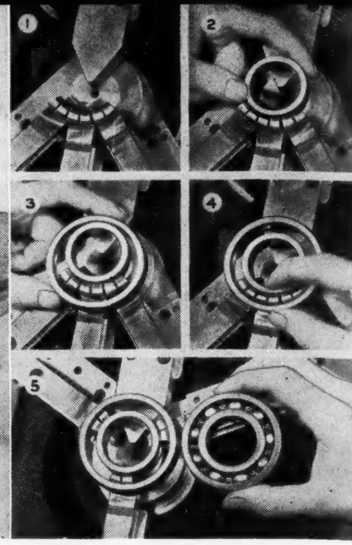
Increased versatility and wider application are features claimed for the new "Multi-Drill" which will be shown by the Commander Mfg. Co., 4225 W. Kinzie St., Chicago, Ill. The addition of optional single-size spindles increases the drill size capacity of this drill head without decreasing its center-to-center capacity. The single spindles are available for both the No. 500 six-spindle model and the No. 900 eight-spindle model. Booth No. 426.



Ross Full-Flo In-Line Valves

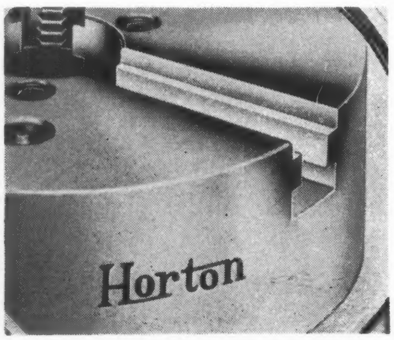
The Ross Operating Valve Co., 120 E. Golden Gate, Detroit, Mich., will demonstrate how combinations of its standard valve bodies and heads make possible over 500 different valve applications. It will be seen from the illustration that a standard three-way solenoid valve is

composed of three basic units. Both normally open and normally closed models are available in 1/4- to 1 1/4-inch sizes for straightway and three-way applications. Booth No. 139.



Horton Chucks with Flame-Hardened Jaw Ways

The E. Horton & Son Co., Windsor Locks, Conn., will feature at the exposition lathe chucks with bodies having jaw ways that are hardened by flame treatment. The jaw ways are flame-hardened to prolong the life of the chuck, as well as to maintain its initial accuracy and gripping power. The exhibit also includes the company's new "Life Guard" chucks, with replaceable coverings designed to seal them against oil, water, emery, chips, etc. Other products to be shown are aluminum body chucks with steel inserts for jaw ways; scroll combination chucks; face-plates; two-jaw chucks; and an electrically operated chuck. Booth No. 406.

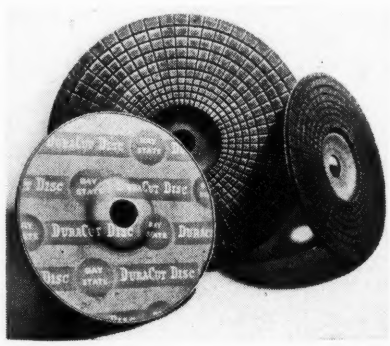


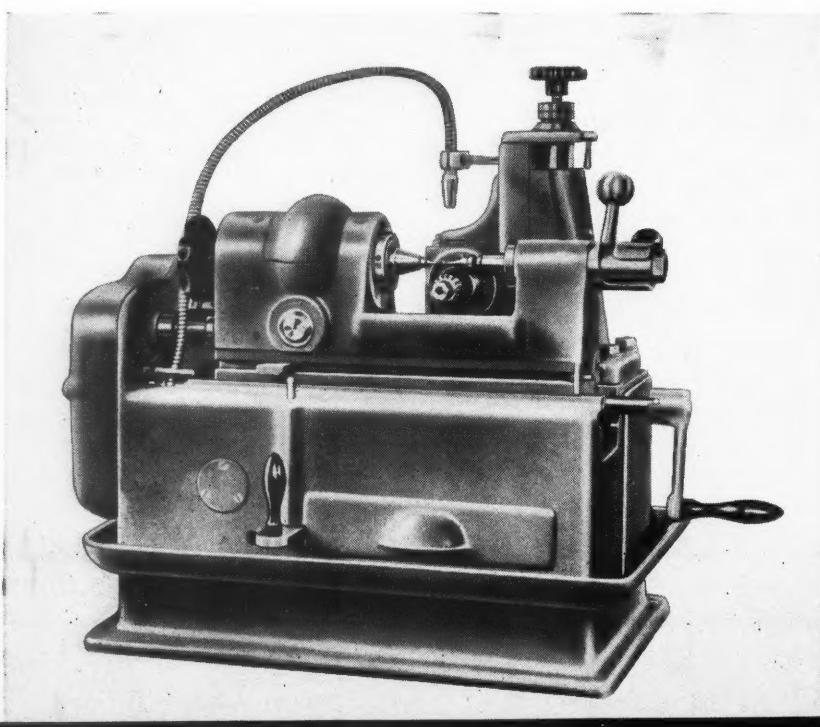
Sheffield Measuring and Inspection Gages

The exhibit of the Sheffield Corporation, Dayton 1, Ohio, will include the latest models and applications of measuring instruments, as well as automatic gaging machines. The ball-bearing "Selectionaire" here illustrated is a typical new Sheffield development. This air-operated instrument is used for matching races and balls for bearing assemblies. It serves to control radial play automatically within any desired tolerance, as well as reduce production costs. The five steps in using the "Selectionaire" to determine exactly how much space is left between the inner and outer races for the balls before assembly are shown in the five views to the right. Booth No. 836.

Automatic Gear-Hobbing Machine

Koepfer automatic gear-hobbing machine designed to mill small gears and pinions for precision instruments. Exhibited by the George Scherr Co., Inc., 202 Lafayette St., New York 12, N. Y. This machine has a minimum milling diameter capacity of 5/64 inch, a maximum milling diameter of 2 inches, and a maximum milling length of 1 5/8 inches. It will cut precision gears having any number of teeth from 6 to 200. Booth No. 209.





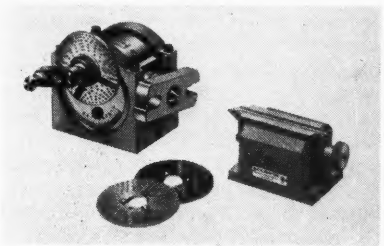
"DuraCut" Flexible Abrasive Disks

"DuraCut" flexible abrasive disks, 7 and 9 inches in diameter by 1/8 inch thick, developed by Bay State Abrasive Products Co., Westboro, Mass., to provide greater economy; longer life; faster; sustained rate of cutting; increased labor saving because of less frequent changing of disks; greater strength and safety (non-tearing); wide variety of grits and grades to permit better control over rate of cut and finish; and choice of raised hub or flat shape design. Booth No. 966.

Marvin Dividing Head

A new dividing head that is designed to meet a wide range of indexing requirements will be exhibited by Marvin Machine Products, Inc., 414 Ford Bldg., Detroit 26, Mich. It is adapted for dividing operations in layout work; squaring shafts; fluting taps; gear-cutting; and milling splines, reamers, cams, and hexagonal-head screws. The dividing head can be tilted from 5 degrees below the horizontal to 30

degrees past the vertical, or a total of 125 degrees, and is supplied with three index-plates having six sets of holes each. The Marvin complete line of machine tool attachments, including verti-



cal mill, slotter, rotary table, and micrometer boring head, will be shown in operation at Booth No. 1010.

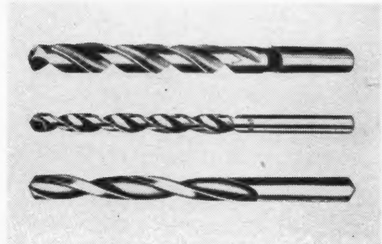
Improved "Kennamatic" Tools

Two styles of tools included in new improved "Kennamatic" line featuring solid vertically positioned, mechanically held, indexable Kennametal inserts. These new tools, together with Type H clamped-on tools; wear-resistant elements; balls for hole sizing; strip mill rolls; disk files; saws for wood and plastics; router bits; and specimens of "Kentanium" (the new high-temper-

ature titanium alloy), will be exhibited by Kennametal Inc., Latrobe, Pa. Booth No. 914.

Carbide-Tipped and Solid Carbide Drills

Carbide twist drills included in the exhibit of the Super Tool Co., 21650 Hoover Road, Detroit 13, Mich. A standard carbide-tipped drill is shown in the upper view, a fast-spiral carbide-tipped drill in the center, and a slow-



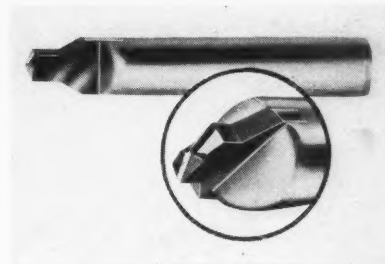
spiral solid-carbide drill in the lower view. The solid-carbide drills are made in sizes from 1/4 inch in diameter down to the No. 53 size. Carbide-tipped drills range from 1 inch in diameter to the No. 32 size in the regular spiral type and from 1/2 inch in diameter to the No. 15 size in the fast-spiral type. Slow-spiral drills are made in sizes from 1/2 inch to No. 32. Booth No. 315.

Hallowell "Carry-Tool"

New "Carry-Tool" made of heavy gage steel with two large drawers designed to carry a full complement of tools. The drawers slide easily on ball bearings when loaded or empty. This carrier is adapted for use in the shop, on the assembly line, and in the tool-room. It will be exhibited by the Standard Pressed Steel Co., Jenkintown 19, Pa. Booth No. 128.

Center Drill for Hardened Steel

Center drill for hardened steel recently announced by National Tool Salvage Co., 6511 Epworth Blvd., Detroit 10, Mich. This tool was originally developed for use in the manufacturer's own shop where it was necessary to drill new centers in tools that had been ground off or in tools with centers that



were so worn as to be useless. It has the advantage of permitting centers to be drilled in such tools without annealing. Booth No. 1140.

Moore Jig Grinder

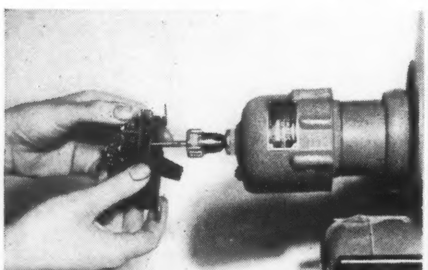
New No. 2 model jig grinder designed for rapid, accurate grinding of any regular or irregular contour, as well as straight and tapered holes, to be demonstrated by the Moore Special Tool Co., Inc., 734 Union Ave., Bridgeport 7, Conn. New features include angular and indexing device built into the main spindle and a newly developed slot-grinding attachment. Booth No. 1007.

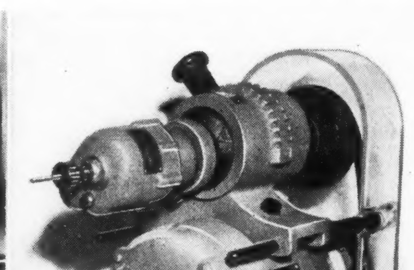
J & S Milling Vise Attachments

"Down-Hold" vise jaws and parallel attachments applied to machine vises employed for production milling operations. These attachments will be demonstrated by the J & S Tool Co., Inc., 477 Main St., East Orange, N. J. The new jaws have been designed to insure gripping the work with a downward pressure, which will hold it firmly in contact with the supporting parallels. Can be easily attached to any type and size machine too! vise. Booth No. 954.

Bench "Torqomatic" for Tapping and Drilling

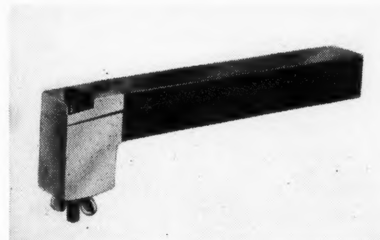
Bench type torque-driven "Torqomatic" adapted for tapping and drilling operations. This complete unit, to be exhibited by the Charles L. Jarvis Co., Middletown, Conn., consists of a built-in type "Torqomatic" with plastic-guard-enclosed pulley drive powered by an electric motor. Available in three models with capacities of 0 to 3/16 inch; 3/16 to 5/16 inch; and 5/16 to 5/8 inch. This company will also have on display "Multi-Tappers," precision machine-ground tungsten-carbide rotary files, solid carbide reamers, end-mills, knurls, and boring bits. In addition, there will be a working demonstration of the Jarvis flexible-shaft machines. Booth No. 807.



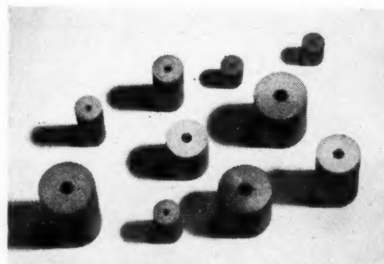


Ejector Tool-Holders with Chrome-Plated Heads

Hard chromium-plating of the heads is announced as an important feature in the design of the new ejector tool-holders for solid carbide inserts to be exhibited by the Super Tool Co., 21650 Hoover Road, Detroit 13, Mich. Chromium-plating of the head is said to increase the life of the holder greatly by eliminating chip erosion. Design features include a new method of clamping action and stress-free, rugged support of the blade; locking screw on top of the holder, where it is easily accessible for fast interchanging of the insert without removing the holder from the toolpost; wing nut on the bottom that eliminates the need of a wrench for locking the adjusting screw; knock-out hole for easy removal of insert; and elimination of offsets and excessive overhangs to facilitate setting up of



adjacent holders. Other features include heat-treated alloy steel shanks and broached holes that fully enclose the insert. Booth No. 315.



Carboloy Header Die Nibs

Cemented-carbide header die nibs for use in heading bolts, screws, etc., developed by Carboloy Company, Inc., 11147 E. 8 Mile Road, Detroit 32, Mich. These die nibs in rough cored form are now carried in stock to facilitate faster delivery of standard header die nibs. The seventeen sizes available range from 9/16 inch outside diameter by 3/4 inch long with cored hole size of 0.060 inch to 1 1/4 inches outside diameter by 2 1/8 inches long with cored hole size of 0.330 inch. The seven smaller sizes are stocked in Carboloy Grade 55B, and the ten larger sizes in Grade 190. Booth No. 736.

Palatable Food for Tool Engineer and Production Man

IN planning any diet for the improvement of the human body, the physician attempts to include foods that will supply the vitamins necessary for better general health or to meet specific needs. The greater the variety of foods, the more likely that the man who is endeavoring to improve his physical being will adhere to the prescribed eating course.

In some ways, the job of the editor of a technical magazine resembles that of a doctor who sets up such a regimen. The capable editor always strives to publish as great a variety of articles as possible in each issue of his magazine and to make certain that the articles are of maximum practical value.

It is our belief that the special Tool Engineering Section of this number of MACHINERY meets those aims in a distinctive manner and will "satisfy the appetite" of the readers, whether they are primarily concerned with tool engineering, production problems, or manufacturing costs.

Two of the articles deal with remarkable manufacturing processes of recent development. Hot-machining of metals is a development that makes possible the rapid cutting of high-temperature resistant alloys. In this process, metals are heated to temperatures as high as 1650 degrees F. to make them more susceptible to cutting and to reduce the power required for the machining operation. While this process has previously been described in the technical press, the article in this issue gives specific information regarding the proper design of the tools to be used in hot-machining operations on the lathe.

"Marforming" is a new process for the deep-drawing and forming of sheet metal which seems to combine the best features of rubber-using methods and steel dies, and utilizes hydraulic pressure both above and below the work instead of in one direction only, as heretofore. The result is that unusually deep draws can be accomplished without annealing and without the formation of wrinkles, even in instances where surfaces at right angles to each other are connected with fillets of small radii.

Another article describes in detail how the tool research department of the Ford Motor Co. constantly investigates the performance of tools being used in production operations and tools recommended by suppliers. Whenever potential savings, as determined by analysts in this department, indicate that the purchase of new equipment is warranted, buying recommendations are made to the management.

Other articles outline the way in which shops can cut manufacturing costs through a study of gaging methods, by analyzing circular sawing operations, and by employing production methods comparable to those adopted for manufacturing the latest torque converter of the automobile industry.

Our readers should find this issue both "palatable" and beneficial.

Charles O. Herb

EDITOR

Functional

MUCH has been written about the advantages of functional checks for machine elements, and the basic concepts are generally understood and accepted. Although sometimes erroneously called a composite check, a functional check is simply a means of inspection that duplicates, or comes close to duplicating, the final use of a product. The closer the use is approached, the more reliable and functional the check becomes.

An example of a functional check of a refrigerator compressor bearing is illustrated in the drawing Fig. 1. In production, the size of the compressor bore is controlled at the machine by air-gage readings in ten-thousandths of an inch, but the final check is done with a plug gage which duplicates the fit of the shaft in the bearing. The inspection with the plug gage in this case is the functional check, and that with the air gage the analytical check. The latter tells the operator when the bore size at the boring machine is out of tolerance; but it cannot determine whether or not the bore is straight for its entire length. It is not a functional check like that made with the plug gage.

In the case of threads, many instruments are available for inspecting the various elements—precision wires and supermicrometers check the size; comparators of various types the shape; and other equipment the lead and "drunkenness" or incremental lead error. These instruments have a single objective—to control and correct machine errors or variations. They insure that the functional check requirements, such as shown in Fig. 2, are satisfied. In the case of the male thread, the functional check is satisfied when the female gage, which duplicates the nut, shows the correct fit. Likewise, the functional check requirement of the tapped hole is that a threaded plug (which might be called a facsimile of the mating screw) fit the threaded hole satisfactorily.

Gear trains are complicated mechanisms, and it is seldom possible to check gearing in a manner that exactly duplicates operating conditions. The cost of making truly functional tests of gear trains for the vast variety of machine elements using gears would be prohibitive, especially in highly competitive industries and for low-priced commodities. However, functional checks of gearing are quite common in machine tool manufacture, but gears for machine tools are not made on a mass production basis and the required accuracy often warrants elaborate functional checks on important components.

The closest approach to mass-production functional gear checks is found in the automotive and aircraft industries. Several manufacturers of automobile transmission gears "speed-test" every set of gears under load as a final operation, and practically all rear-end hypoid drives pro-

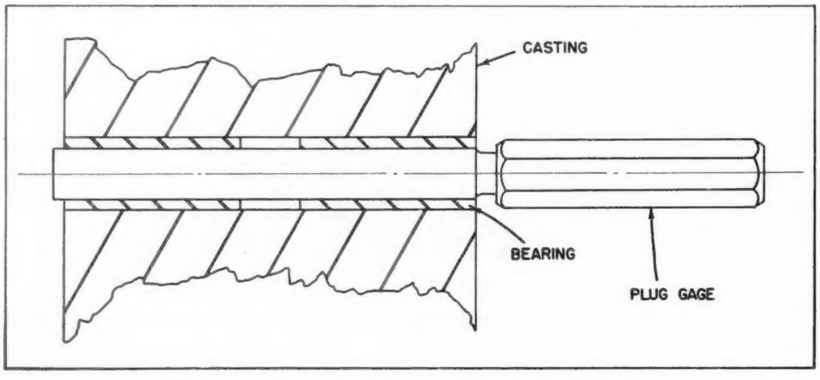


Fig. 1. Diagrammatic sketch illustrating the way in which a plug gage performs a functional check of a refrigerator compressor bearing

Checking of Gear Teeth

By LOUIS D. MARTIN, Gear Engineer
Camera Works, Eastman Kodak Co.
Rochester, N. Y.

duced in the automotive field are tested under conditions simulating final service. As a matter of fact, this is the only practical way of checking bevel gearing for tooth bearing under load. The several analytical instruments used for determining eccentricity and tooth spacing in manufacture only serve as aids to these final functional checks.

The gaging equipment employed in the manufacture of gears usually includes several types of analytical instruments—an involute checker, a lead checker, and a tooth-spacing checker. All of these are useful in making an occasional check when the job is started or when trouble is experienced. However, just as costs would be prohibitive to check every inch of bar stock for its physical properties, it would be too expensive to check by slow analytical methods all tooth profiles on every gear for each gear-tooth error that might occur. By the laws of probability, this should not be necessary, but means should be provided to give a quick functional check of gear teeth.

The best way of checking gears is to run them either with the gears with which they are to mate or with a master of known accuracy. An early type of variable-center distance fixture designed to check the composite error in gear teeth is shown in Fig. 3. This fixture—about forty years old—was used to run two gears together and check their radial displacement. The small incremental separations (which we now call tooth-to-tooth composite error) were termed "kick-out," probably because profile errors were so great in those days as to induce an impression of disengagement of the teeth. This equipment represents an early attempt at a functional check.

The variable-center distance fixture shown in Fig. 4 makes a functional check of worm-gears—one of several types of gears that do not readily lend themselves to analytical checks. Size, tooth bearing, and uniform angular motion are important requirements of this gearing. The fixture is set to the correct center distance for an inspection by the master cylinders seen in front of the fixture. When the worm is rotated on its centers, the total composite error shows up as radial displacement, and is read on the indicator that contacts the end of the work-slide. Tooth bearing can be observed by coating the gear being checked with a marking compound. If the worm-gear were used primarily for transmitting a load instead of obtaining motion, a running test would be required to make the check truly functional.

Bevel gears are checked best by procedures that closely duplicate use. It is not possible, for example, to check the tooth profile or spiral angle of spiral-bevel gears except by reference to machine settings and by making a tooth-bearing test. Functional checks have been found entirely reliable for such gearing.

The Gleason fixture shown in Fig. 5 was designed specifically to meet the requirements of instrument gears. Bevel gears are tested on this fixture for total composite error when mounted in their correct angular positions. One of the work quills is resiliently mounted against a dial indicator which measures radial displacement as one of the gears drives the other. It is also possible to "speed-test" gears on this fixture and to test tooth bearing at the proper backlash setting. Tests made with this fixture are close to being truly functional.

The Fellows Red Liner (Fig. 6) is equipped with a mechanical charting device to record radial displacements as gear teeth engage one an-

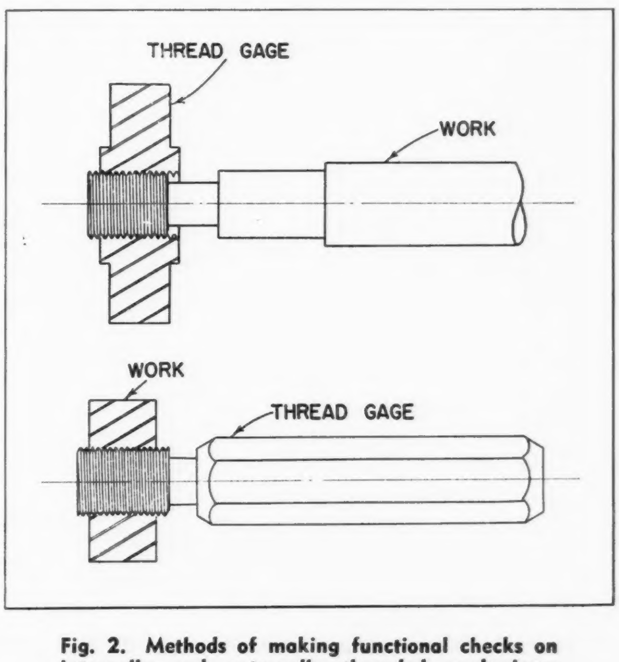


Fig. 2. Methods of making functional checks on internally and externally threaded work-pieces

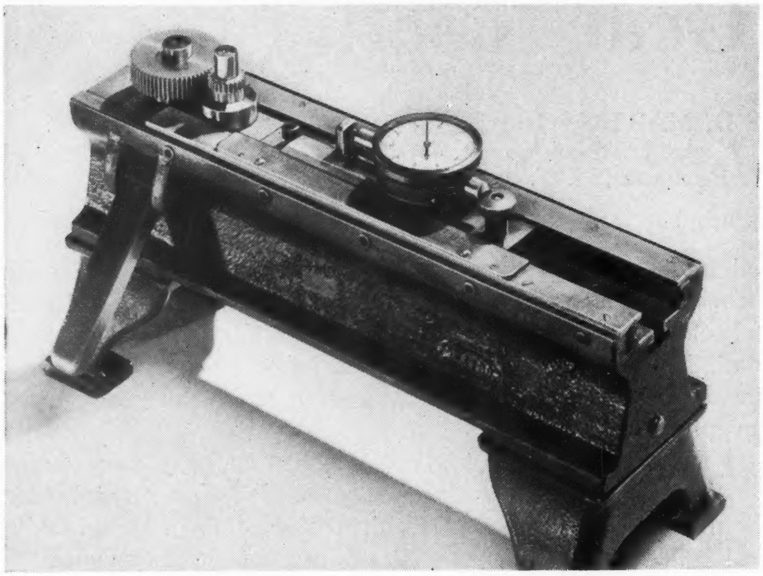


Fig. 3. Early type of variable-center distance fixture that was designed to check the composite error in gear teeth by running two gears together and checking their radial displacement

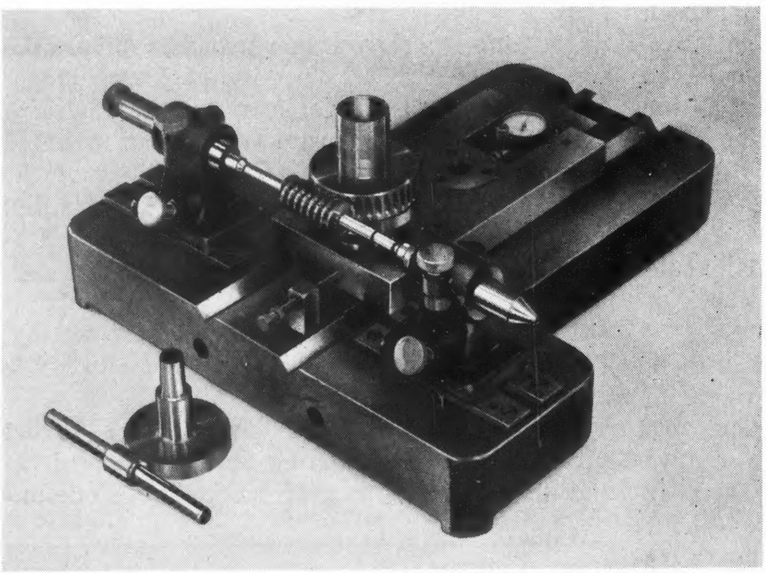


Fig. 4. Another variable-center distance fixture designed for making a functional check of worm-gears. Master cylinders are seen at the front of the fixture

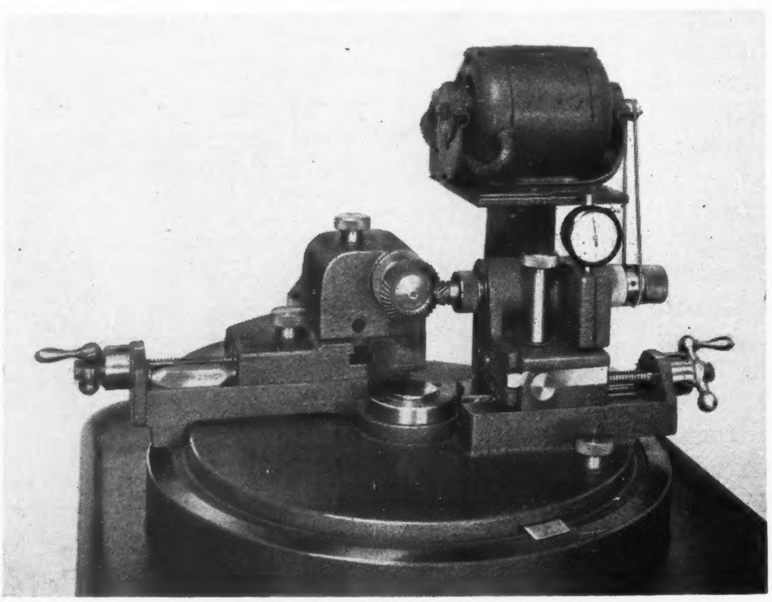


Fig. 5. Fixture employed for checking the total composite error in bevel gears, performing speed tests on gears, and testing tooth bearing with the fixture set for the proper amount of backlash

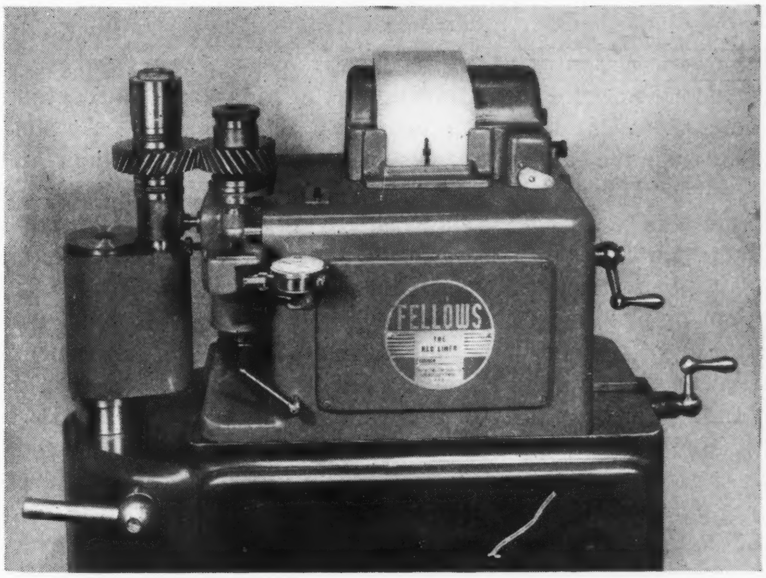


Fig. 6. Fellows Red Liner is equipped with a mechanical charting device that records radial displacements as gear teeth engage each other

other. This instrument is based on the principle of two disks driving each other without slippage, one of the disks being rigidly fixed and the other mounted on an arbor which is attached to a pivotable arm that actuates the recording pen through a mechanical linkage.

If the disks are perfectly round and run true on their axes without slippage, the driving disk will transmit uniform angular motion to the driven one and the recording pen will produce a straight line as the chart paper passes under it. If gears are substituted for the disks, any small errors in the teeth, as they pass into and out of engagement, will produce small changes in angular motion, and the pen will make a series of wiggles and curves on the chart instead of a straight line. In addition to size, this instrument will check total composite error of gear teeth due to run-out, pitch error, tooth thickness variation, profile error, and lateral run-out.

This fixture is dependent on circular master gears for checking the work. If there are inaccuracies in the masters, the readings will be affected, since errors in the masters may be added to or subtracted from those of the work, depending on whether the errors in the master and work are in or out of phase with each other. Also, when the size of the master differs from that of the work, there is a "hunting tooth" effect between the master and the work, and the errors of the master and gear will not be in any fixed order.

This type of instrument, while it does not give a functional check of gear teeth, comes close in principle to that goal. Since instrument gears that operate with metal to metal are not highly stressed, it comes closer to being functional for gears of this type than for highly stressed, high-speed gearing.

A comparatively new instrument for obtaining a composite check of gear teeth is the Kodak "Conju-Gage," shown in the heading illustration. This instrument will check spur or helical gears up to 8 1/4 inches in diameter, and uses one checking element known as a "master worm section" for all gears of the same normal pitch and

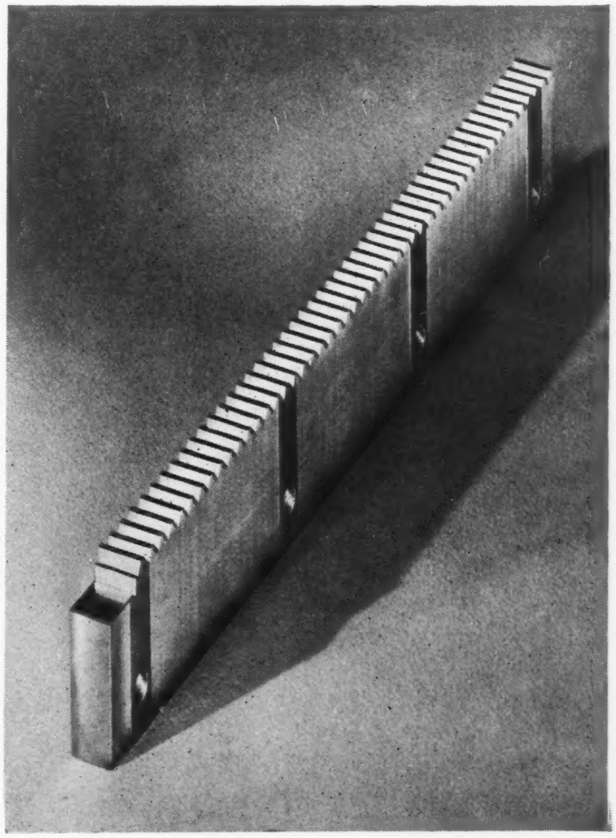


Fig. 7. Master worm section of the Kodak "Conju-Gage," which may be used for checking all gears of the same normal pitch and pressure angle

pressure angle. The checking element, shown in Fig. 7, looks like a rack at first glance, but actually is a section of a large helicoid, produced by grinding a series of sections, mounted in a large drum, as a single-thread worm. Master worm sections have been made with a normal diametral pitch as fine as 175, and to an extremely high degree of accuracy. They can be used in the same manner as a rack for checking gears.

While a straight-toothed rack is conjugate to a spur gear, helical racks have teeth at an angle, and are fully conjugate only to helical gears of that particular helix angle and hand. This is the fundamental difference between a rack and a master worm section such as this. The latter, because it is part of a helicoidal surface, is conjugate to both spur or helical gears, regardless of hand or helix angle. Therefore spur and helical gears of the same normal pitch and pressure angle can all be checked by a single worm section. Fig. 8 shows a collection of such gears.

One of the features of the "Conju-Gage" is an electronic charting device that is capable of responding to 100 cycles per second. Its recorder can be adjusted to any of the four magnifications —100, 200, 400, and 800 to 1—and the paper speed can be changed to provide a contracted chart, for paper economy, where a permanent record of all gears checked is required.

The work carriage, which can be rotated to suit various helix angles, is mounted on a ball-bearing slide with a moment of inertia calculated to give a sensitivity response of 60 cycles per second for 0.001 inch of travel. This results in the exploration of a large number of points on the tooth profile. The pressure between the work and master can be varied and made to agree with accepted standards.

Typical charts of pinions made on the "Conju-Gage" at two different magnifications are shown in Fig. 9. Such charts are produced in a matter of seconds, and reveal a great deal more than checks made by means of the much slower analytical devices for checking individual errors.

Backlash in gears has been defined as the play between mating gear teeth, but this is the concept of a single pair of gears. Functional backlash is something else; it is the actual backlash obtained in a gear train assembled in a case or housing. It takes into account the variations in gear centers, run-out of anti-friction bearings, and even the expansion and contraction of the gear housing and gears due to temperature changes.

The accumulated backlash of the driven gear is seldom, if ever, of constant magnitude, unless there is no total composite error in the engaging teeth. If gear ratios are non-integral, there is a recurring orientation of high and low spots due to the varying amounts of eccentricity in each pair of assembled gears. For many metal-to-metal applications, such as those found in measuring and optical devices, functional backlash control must be accompanied by similar controls of total composite errors due to errors in the gear teeth themselves. So-called "zero-backlash" gears are gears that are almost perfect and have practically no composite error. Small amounts

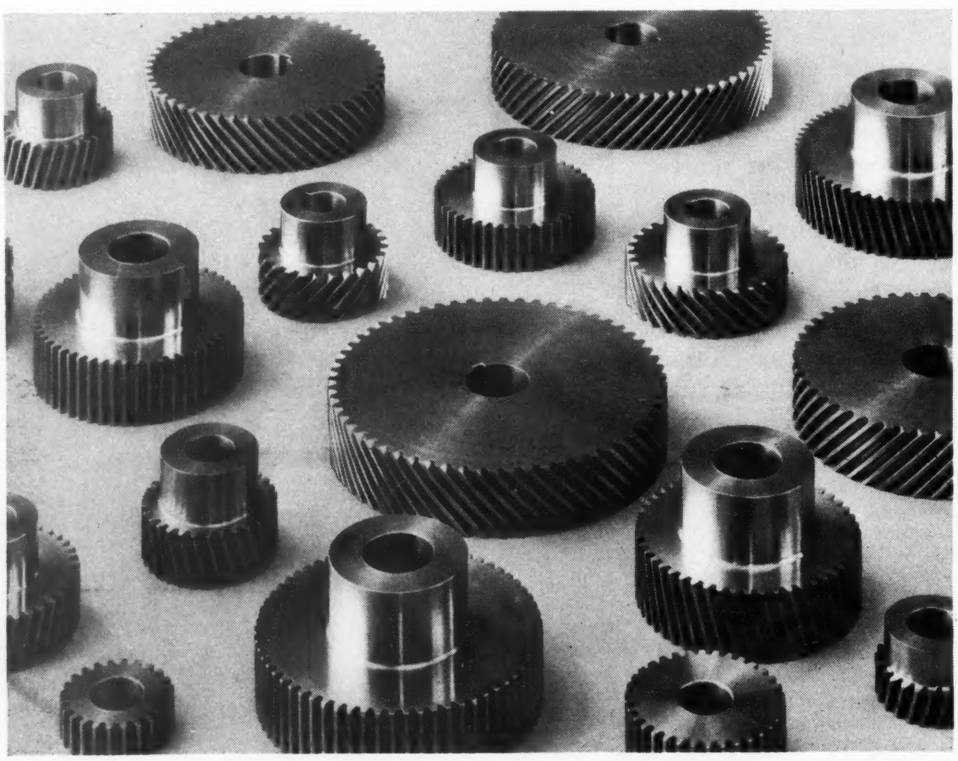


Fig. 8. Gears of different sizes but having the same normal pitch and pressure angle which were checked on the "Conju-Gage" by means of a single master worm section

of backlash are absorbed by the residual errors integrated over the arc of engagement.

There are a number of ways of checking backlash in an individual gear or in a set of gears. Many of these methods are not realistic, nor do they satisfy functional requirements. Limitations in existing devices are not readily recognized and often the methods used to measure backlash do not give the expected results.

Any means of checking backlash of a gear, either by taking a direct or a related measurement, is not very useful if it ignores the gear bore. To get close to a functional backlash check, gears should be checked with a master of some kind and rotated on their axes. This is convenient to do when a composite check is being made. The fixture can be set to the nominal center distance, and backlash determined as a change in the center distance. When measured in this manner, backlash is equal to the change in center distance times twice the tangent of the normal pressure angle. Thus, for gears of a 14 1/2-degree normal pressure angle having a center distance reduction of 0.002 inch, the backlash would be 0.001 inch, provided the size of the master is taken into account and allowed for.

When backlash is measured as a center-distance change, it makes no appreciable difference (on gears or pinions of standard tooth proportions) whether a circular gear, rack, or Kodak "Conju-Gage" worm section is used as the checking element, except on pinions having small numbers of teeth. Here, small backlash differences are due to a small change in the arc of engagement, which is affected by and varies with the pressure angle. Engagement is greater as the master becomes larger and approaches a rack.

When precise backlash measurements are required, several factors must be considered. If a circular master gear is used, the exact amount that it is over or under size must be known and corrections made. The difference in the size of the master affects size readings of the gear or pinion in varying amounts, depending on the number of teeth in the gear or pinion being checked and the amount they depart from standard proportions. If two similar gears are under or over the standard pitch diameter, as expressed by the number of teeth divided by the diametral pitch, the center distance between them (when tightly meshed) will not be equal to the pitch diameter change. This change in center distance will be small for gears having a large number of teeth and appreciable for pinions having a small number of teeth.

By the same token, an enlarged (over-size) pinion when checked with a large gear will give a different reading of size than when checked with a similar pinion. Mathematical corrections must be made when non-standard gears and pinions are checked. Such corrections are necessary due to the change in the pressure angle that occurs when non-standard gears operate together.

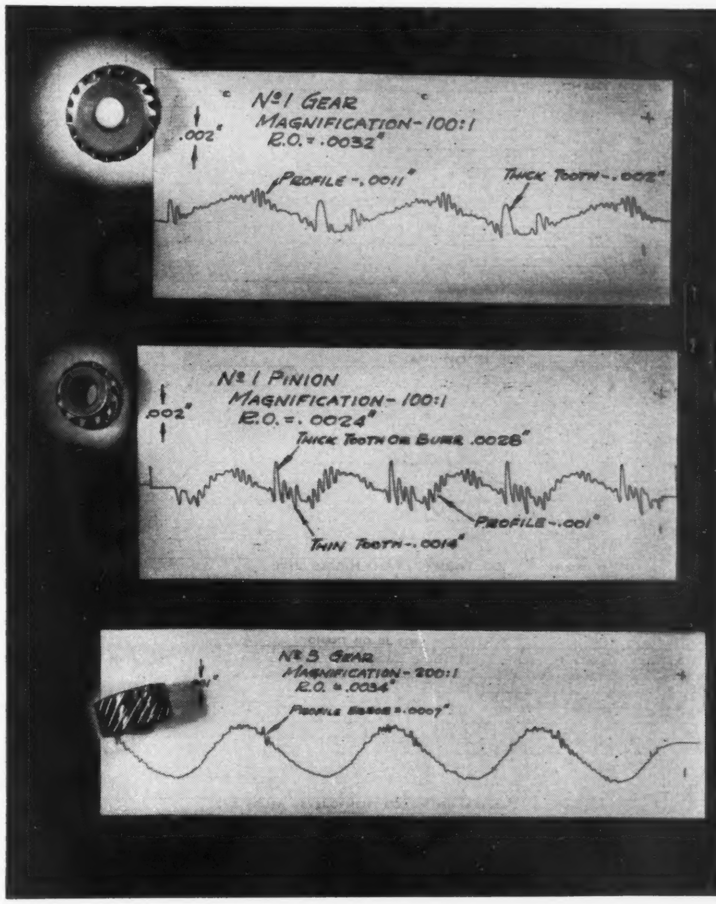


Fig. 9. Typical charts of pinions made on the "Conju-Gage" at two different magnifications which reveal considerably more concerning gear errors than analytical checking devices

When backlash measurements are taken by means of a rack or master worm section, no correction is required. This is because the operating and standard pressure angles in either a rack or worm section meshing with any gear or pinion, cut over or under standard proportions, are always the same.

The larger the master gear used to check enlarged pinions with few teeth for backlash, the less difference there is between the calculated and apparent center distance. When the diameter of the gear reaches infinity, there will be no difference. Such a gear would be a rack.

Experience has proved that the composite check does not penalize production unduly and yet gives the factor of safety—as regards quality—that is essential to successful manufacture.

[An article dealing with the functional checking of backlash in gears, written by the same author, will appear in an early number of MACHINERY.—EDITOR]

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
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Sales Management Engineers
New York and Philadelphia

Persistency is a Virtue—But

MAYBE you haven't heard the story of the prospect so thoroughly tired of an equipment salesman's persistency that he finally exclaimed: "Get out of my office. Don't come back until I invite you." The salesman picked up his hat and coat and left. But he did not put them on. He loitered in the corridor. Then, returning, he rapped on the prospect's door and heard the reply, "Come in." "Thanks for the invitation," he said as he entered. "Well I'll be blasted," exclaimed the prospect, "I guess after all you do deserve the order."

Though overly persistent interviews almost never turn out this well, most of us lack sufficient persistency. We lack what Webster says is "the ability to go on resolutely in spite of opposition."

Persistence applied to winning an order usually depends upon two important principles:

1. Each successive approach should carry an idea new to the prospect, or at least an old idea with a "new front."
2. Each approach should be guided by keen observation of the particular interest of the prospect and his reaction, and should be garbed with diplomacy and tact.

Let us examine these principles more closely. Unless new ideas are presented, the salesman soon becomes a bore. Repetition certainly has value, but an old idea may be miraculously strengthened by variety in approach. Also, we must present new ideas which reshape the argument in order to stimulate the prospect. Above all, new ideas will generate in the prospect's mind the feeling that the salesman is genuinely interested in his problems.

The following are a couple of examples of a new approach that opens the way for a restatement of old ideas: "It just occurred to me," says a salesman "that sooner or later you may have to turn and finish some parts made from this new Super XYZ steel on the machine I sell. Here are some samples I brought with me of work done and costs. They'll interest you."

"You know that old lathe you considered replacing with our new model T still has some life left in it. I have been looking around and here is the name of a possible purchaser. He doesn't need particularly fine work. Maybe he will take it off your hands at a good salvage value."

Too often our approach is not down the "right alley." For example, I know of a certain shop superintendent extremely proud of the grinding and finishing results he is obtaining. One grinder salesman's approach followed these lines: "You can get better results by using our grinder." Another salesman followed this method: "You sure have a fine reputation for the grinding work you do in your shop. May I look at some samples of the work you do?" Examining these, the salesman comments favorably. Then he presents samples of the work his machine will do, and simply asks for the prospect's comments. Since these results are really superior, he gains the superintendent's interest.

In another case, a salesman meets the prospect's works manager while the latter is touring the shop. He makes himself known and starts to explain the quality of materials used in the equipment he sells. The works manager listens a minute, and then passes on. The salesman's approach was out of place because he talked about details rather than over-all results.

Persistency is vitally important to every salesman. It is a principle to live by. But it can't be successful without proper technique—to be cultivated of course—and depending upon continuing enthusiasm and genuine customer interest. Let's ask ourselves not only do we persist sufficiently, but also do we direct our efforts in an intelligent and diplomatic manner?

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

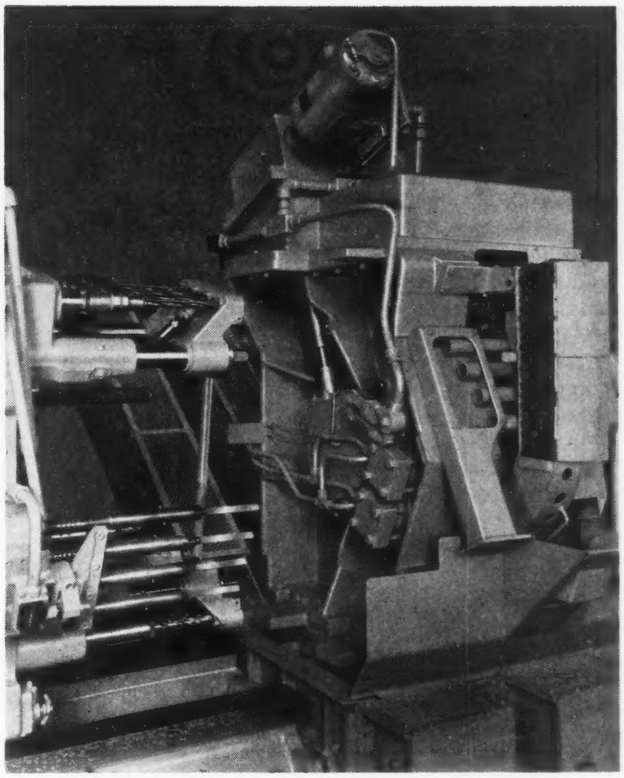


Fig. 2. Close-up view of hopper-fed central indexing fixture of machine shown in Fig. 1

Automatic Piston-Pin Drilling and Reaming Machine

The National Automatic Tool Co., Richmond, Ind., has announced the development of a new hopper-fed automatic multiple-spindle drilling, chamfering, and reaming machine. This machine is shown in Fig. 1 equipped for machining piston-pins in a large automobile plant. The close-up view of the central indexing fixture and hopper feed in Fig. 2 shows some of the tooling in one of the two heads which slide on bed ways at opposite sides of the fixture. With this equipment, the operations of load-

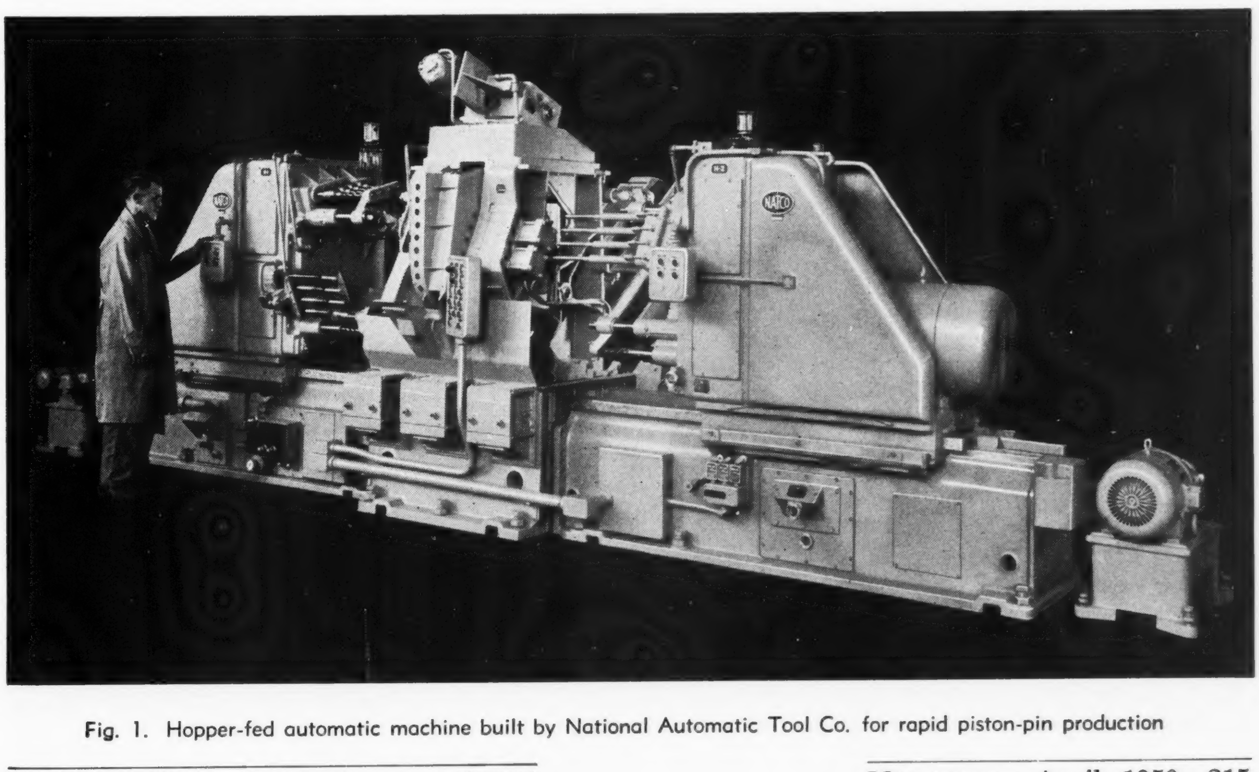


Fig. 1. Hopper-fed automatic machine built by National Automatic Tool Co. for rapid piston-pin production

To obtain additional information on equipment described on this page, see lower part of page 232.

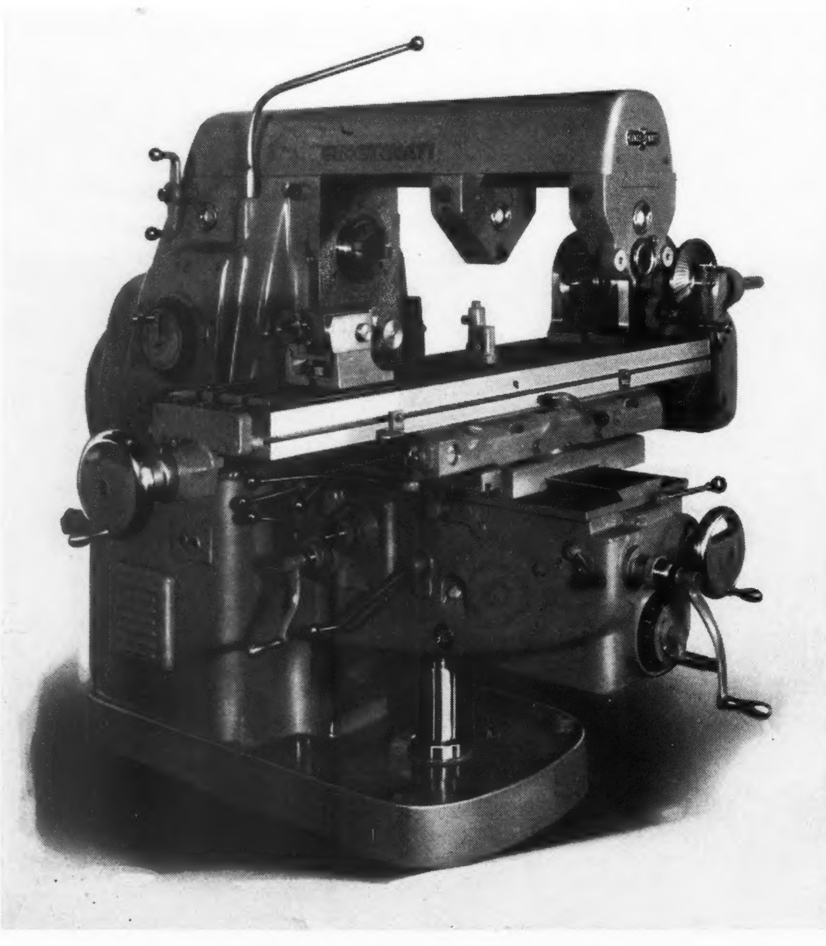
ing, clamping, unclamping, and ejecting the work are all performed automatically.

The push-button controlled automatic cycles perform the drilling, chamfering, and rough- and finish-reaming operations on piston-pins at a production rate of 575 pins per hour. A chip conveyor attached to the rear of the fixture and extending under it carries the chips from the machine.

Four parts are loaded into the central indexing fixture from the hopper at the first position. In the second position, right- and left-hand heads drill four 0.652-inch diameter holes one-fifth of the way through the pins. In the third position, right- and left-hand heads continue the drilling operation two-fifths of the way further and chamfer the ends of the holes. In the fourth position, the right-hand head completes the drilling of the holes while the left-hand head remains idle. In the fifth position, the right-hand head rough-reams the holes through the length of the pins, using an accelerated spindle speed while the left-hand head remains idle. In the sixth position, the right-hand head idles while the left-hand head reams the holes to a diameter of 0.652 to 0.657 inch, using an accelerated spindle speed. The four parts are unloaded in the seventh position after the machining operations are completed. 61

Cincinnati Plain and Universal Milling Machines

A new No. 3MI milling machine, built in plain and universal styles, and driven by a 7 1/2-H.P. motor, has just been announced by the Cincinnati Milling Machine Co., Marburg Ave., Cincinnati 9, Ohio. This machine offers all the advantages of the smaller Nos. 2MI and 2ML models introduced about four years ago. It has wide speed and feed ratios of 60 to 1 and 120 to 1, respectively, designed to cover the latest requirements for all types of milling operations. These wide speed and feed ratios and the rapidity and ease with which speeds and feeds can be changed are among the features developed to adapt this machine for modern tool-room milling operations.



Large size milling machine brought out by Cincinnati Milling Machine Co.

Sixteen spindle speeds, ranging from 25 to 1500 R.P.M., are changed by means of a single crank. This crank operates a hydraulic selector valve, which causes the actual work of shifting gears to be performed hydraulically. A safety interlock prevents the speed-change crank from being moved accidentally while the spindle is rotating.

A mechanical spindle reverse offers quick, easy reversal of spindle rotation to suit the "hand" of the cutter. Feed rates are changed in the same manner as speeds throughout the complete range of sixteen feeds, from 1/4 inch to 30 inches per minute. The crank and indicating dial are located at the front of the knee, readily available for instantaneous changes of feed rates.

Extra metal in the bull gear produces the flywheel effect desired when using sintered-carbide cutters, single-tooth cutters, or end-mills having widely spaced teeth. The spindle nose design of the machine conforms to Milling Machine Manufacturer's standard No. 50.

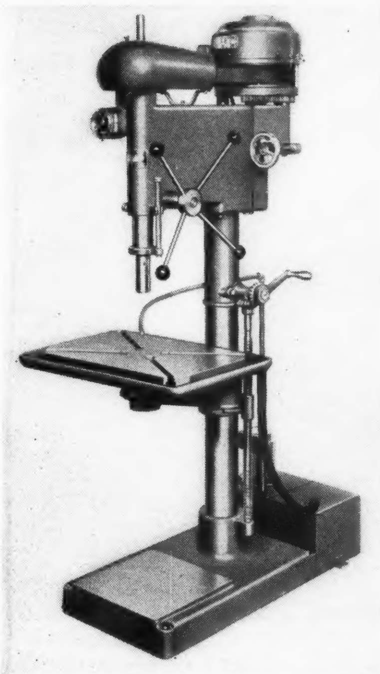
All operating controls are duplicated at the rear working position, on the left-hand side of the column. A multiple disk spring-loaded brake, operated by the disengaging action of the starting lever, stops the spindle instantly when the drive clutch is disengaged.

The large micrometer dials for the manual adjustment controls have deeply cut graduations for clear visibility and can be easily reset.

"Live" rapid traverse movements of the table, at the rate of 150 inches per minute longitudinally and transversely, and 75 inches per minute vertically, are obtained by lever control. Controls for voltages higher than 220 include a transformer which protects the operator by reducing the voltage to 110 at the push-button station.

Many attachments are available for this machine, including circular milling tables, several types of vertical and universal spindle attachments, motorized over-arm, and long- and short-lead driving mechanisms. 62

To obtain additional information on equipment described on this page, see lower part of page 232.



Medium-weight drilling machine introduced by Sibley Machine & Foundry Corporation

Brown & Sharpe Cutter and Tool Grinding Machine

A cutter and tool grinding machine with universal or plain equipment which will swing work or cutters up to 10 inches in diameter between centers has just been brought out by the Brown & Sharpe Mfg. Co., Providence 1, R. I. This machine is designed specifically for the rapid and accurate sharpening of straight and helical milling cutters, formed cutters, straddle and face mills, angular cutters of any angle, side milling cutters, end-mills, straight or tapered reamers, and saws, as well as for light cylindrical, internal, and surface grinding.

The fixed height of the machine is designed to provide a clear view of the wheel and work from the operating positions. Controls at both front and rear of the table enable the operator to assume the most convenient position.

Other outstanding features include unit type double-ended anti-friction wheel-spindle with super-precision, permanently sealed, grease-lubricated bearings; provision for swiveling wheel-spindle in horizontal plane; sliding table mounted on precision-ground steel rollers to provide exceptionally easy movement; transverse movement screw mounted directly above V-way, and precision-ground steel rollers on flat way to eliminate any tendency of carriage to twist; eye-level spindle-elevating handwheel with wide-spaced graduations on rim, and a finger with zero mark which is adjustable around rim of handwheel; table dogs with spring plungers that minimize operating effort at table reversals and that can be used for positive stops; wheel-spindle motor and driving mechanism enclosed in base, out of the way yet easily accessible; and adaptability for easy application of large number of standard and special attachments.

The new No. 10N cutter and

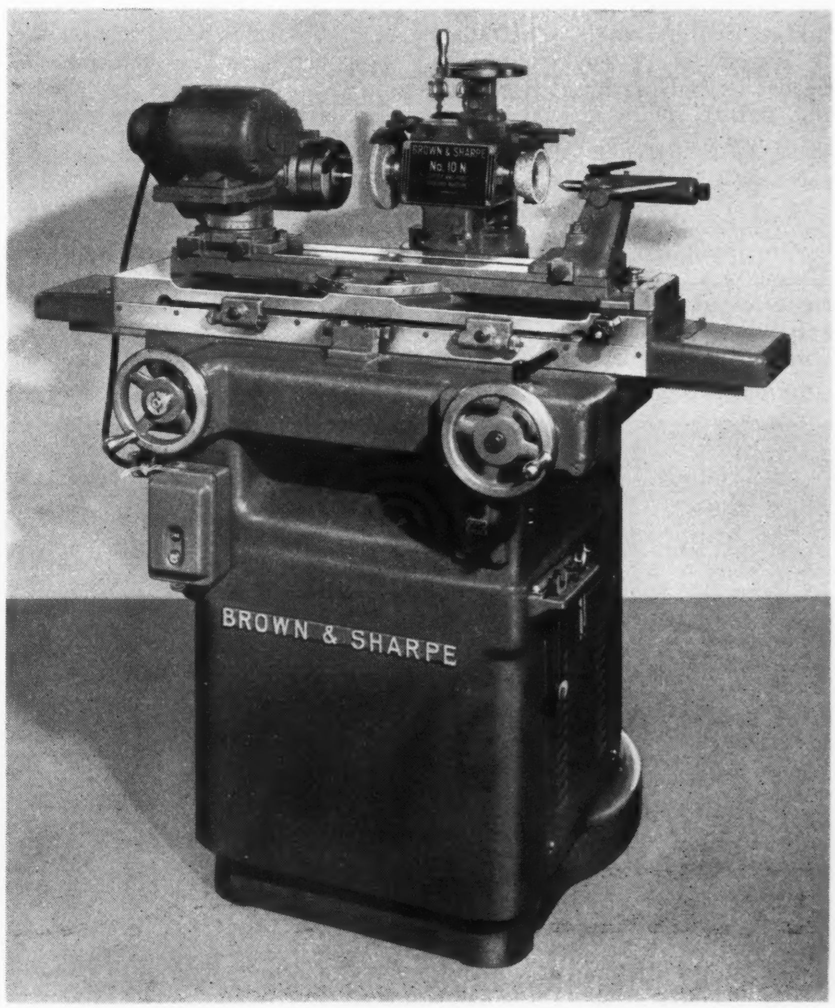


Fig. 1. B & S cutter and tool grinding machine with universal equipment

Sibley Medium-Weight Drilling Machine

A medium-weight Model E 25 sensitive drilling machine with a 25-inch swing has just been introduced by the Sibley Machine & Foundry Corporation, South Bend, Ind. This machine has an 18- by 26-inch table, weighs 765 pounds, and has been developed to fill the gap between the larger, heavier type and the light bench class machines. It is suited for high-speed production and the various requirements of maintenance or small shop work. The variable-speed drive provides the correct spindle speed for any size drill from 1/8 to 1 inch.

A tachometer at the front of the machine shows the actual spindle speed. Five spindle speed ranges, each with a 4 to 1 ratio, are available. These range from a low of 206 to 825 R.P.M., to a high of 540 to 2160 R.P.M., with a three-phase 60-cycle motor. The speed chart on the side of the machine shows the proper speeds for different drill sizes. The machine is driven by a 1 1/2-H.P. motor.

Other important features are full floating ball-bearing spindle with maximum travel of 8 inches; 4 1/2-inch diameter solid column; and table accuracy maintained to limits well within 0.0007 inch in a 6-inch radius. 63

To obtain additional information on equipment described on this page, see lower part of page 232.

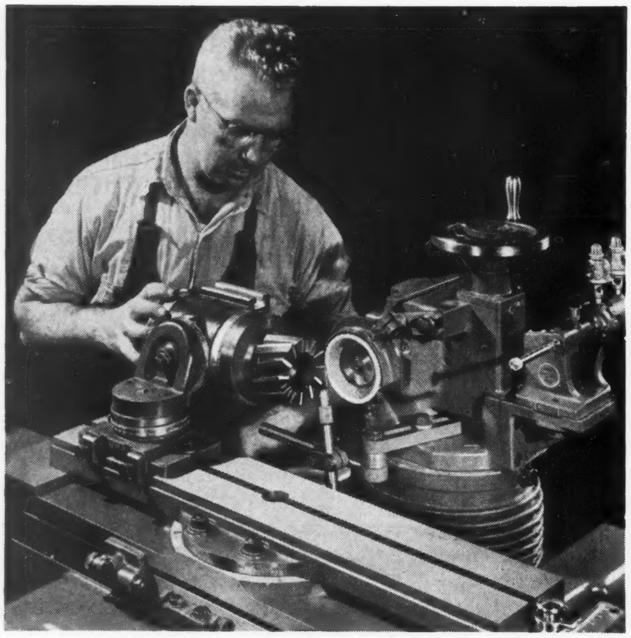


Fig. 2. Cutter and tool grinding machine shown in Fig. 1, set up for sharpening the end teeth of an end-mill

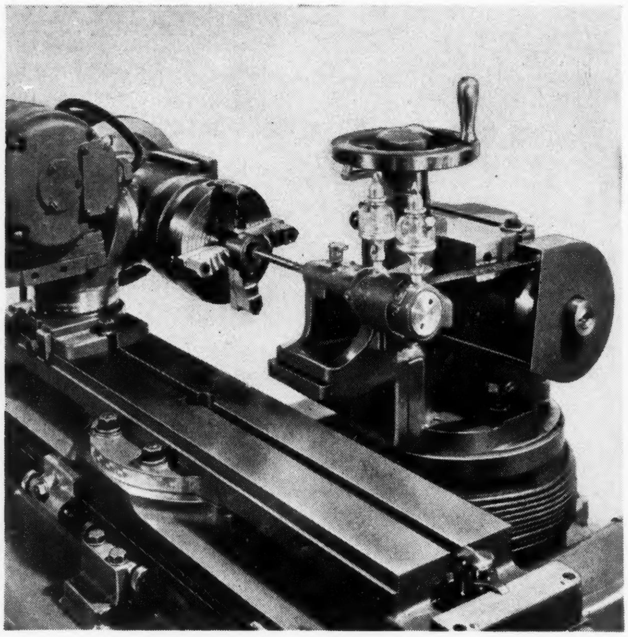


Fig. 3. Machine shown in Fig. 1 set up for precision hole grinding, using headstock and internal grinding fixture

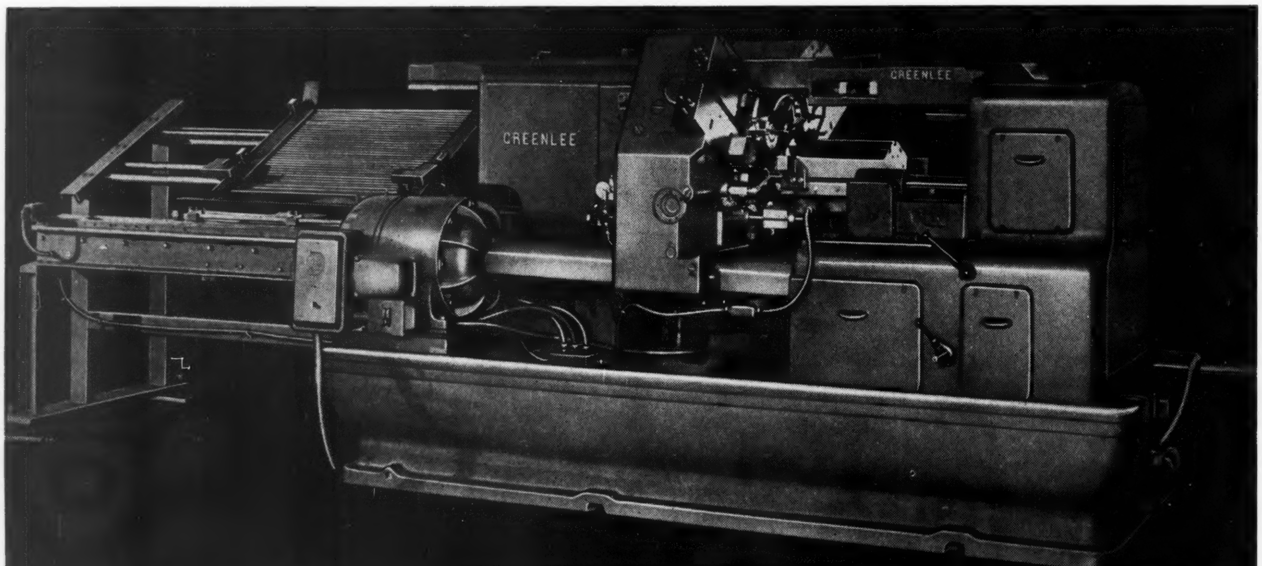
tool grinder with universal equipment is shown in Fig. 1. A set-up for sharpening a shell type end-mill on this machine is illustrated in Fig. 2. The revolving spindle headstock and the internal grinding fixture, both of which are furnished with the machine having universal equipment, are shown in Fig. 3 set up for precision hole grinding. This equipment is available at extra cost for use on the plain grinder. The machine requires a floor space of 49 by 67 1/2 inches, and weighs 1950 pounds. 64

Greenlee Automatic Shaft Machine

Greenlee Bros. & Co., 1863 Mason Ave., Rockford, Ill., recently completed a 1 5/8-inch six-spindle screw machine adapted for handling pre-cut bar and tubular stock in lengths of 30 to 60 inches. This machine has provision for performing a turning operation on the back end of the stock, eliminating a second operation.

The stock is loaded into a magazine at the rear of the machine, which is adjustable for stock of various lengths and holds up to forty bars of 3/4-inch diameter material. An air cylinder, operating a loading bar, advances the stock into the spindle, where it is accurately positioned by a swing type stop which is automatically withdrawn from the tooling area on completing the loading cycle.

At the same time that a new bar is being loaded into the spindle the completed piece is moved forward into a live-roll mechanism,



Six-spindle automatic screw machine with magazine feed built by Greenlee Bros. & Co.

To obtain additional information on equipment described on this page, see lower part of page 232.

which propels it through a sleeve in the gear-box and out through the front of the machine. An outfeed hopper (not shown) stacks the bars, making them available for further processing. 65

South Bend "Light Ten" Lathe

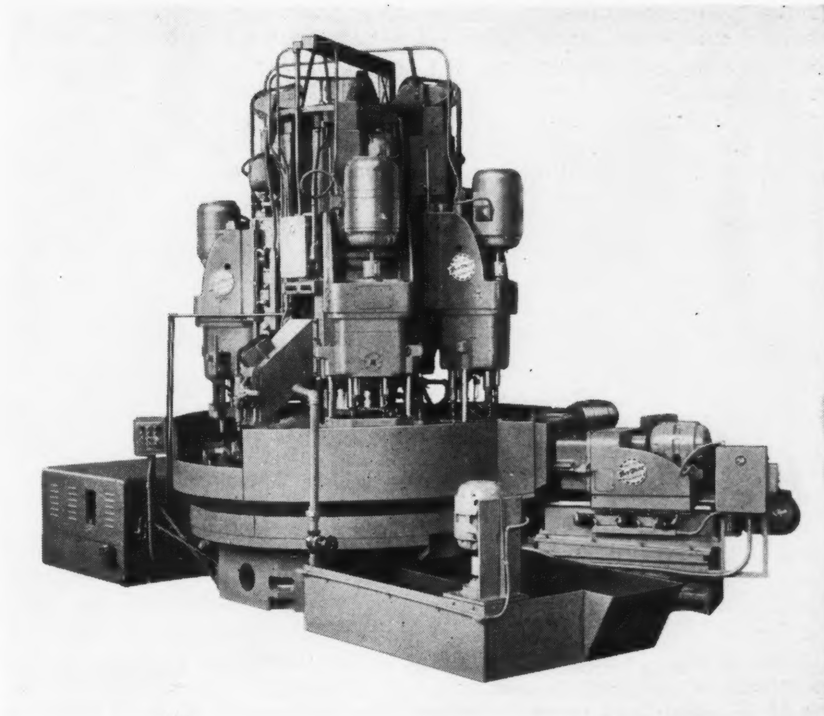
The South Bend Lathe Works, 425 E. Madison St., South Bend 22, Ind., has announced a new popular priced 10-inch quick-change-gear "Light Ten" lathe which is available in four bed lengths. The bed, of special gray iron with a 30 per cent steel content, is designed for extra strength and long wearing qualities. The three V-ways and one flat way are hand-scraped to assure precise alignment of the headstock, tailstock, and carriage.

Bearings for the headstock spindle are of the replaceable bronze sleeve type. Large oil reservoirs and a capillary oiling system provide a complete film of clean filtered oil for the rotating spindle. A ball thrust bearing and take-up nut eliminates end play. The spindle bore is 27/32 inch in diameter, and the maximum collet capacity is 5/8 inch. All bearing surfaces of the headstock spindle are carburized, hardened, and ground. Journal bearing surfaces are super-finished to a smoothness of 5 micro-inches.

The quick-change gear-box provides forty-eight thread cutting feeds, power longitudinal feeds, or power cross-feeds. The apron is equipped with a worm driven by a spline in the lead-screw, and a friction clutch for operating the power cross-feed and the power longitudinal feeds. The threads of the lead-screw are used only for thread cutting. An automatic safety interlock prevents engaging the half-nuts accidentally when the power turning or facing feeds are in operation.

The compound rest is graduated to 180 degrees, swivels to any angle, and has an improved locking device. Both the compound-rest screw and the cross-feed screw have micrometer collars with 0.001-inch graduations.

Two types of horizontal drive units are available — a twelve-speed 48- to 1435-R.P.M. drive using a flat leather belt to the headstock; and a sixteen-speed 52- to 1365-R.P.M. drive with a V-belt to the headstock. 66



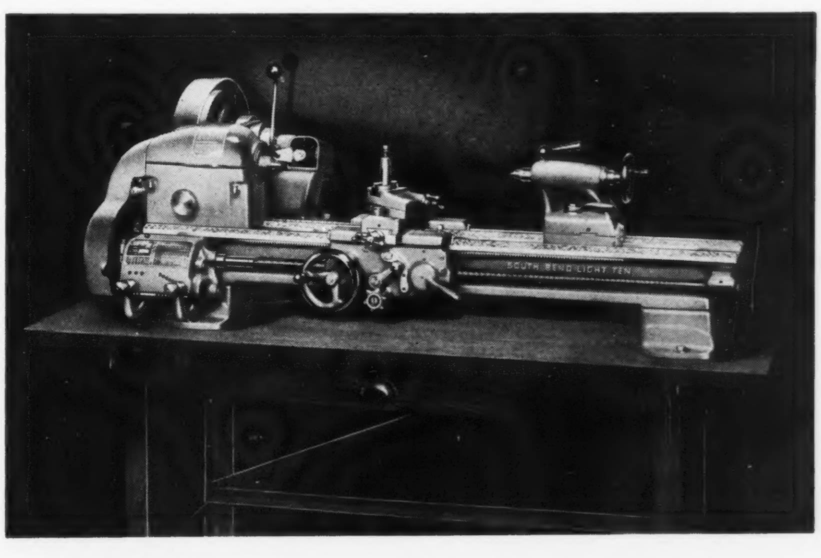
Davis & Thompson "Roto-Matic" drilling and reaming machine

"Roto-Matic" Drilling and Reaming Machine

The "Roto-Matic" station type vertical indexing machine recently developed by the Davis & Thompson Co., 6411 W. Burnham St., Milwaukee 14, Wis., was designed for drilling and reaming two suspension holes and the king-pin hole in automobile front suspension support arms.

Six stations are provided, with two fixtures each, to take both a right- and left-hand part, so that the work-pieces are removed in pairs. There are five working stations and one loading station. After the first cycle of the machine is completed, a pair of finished pieces is removed at each indexing of the table. Indexing is accomplished through a hydraulic mechanism, which is so designed that it eliminates the shock normally encountered during acceleration and deceleration of the table.

"Roto-Matic" power heads, in both vertical and horizontal mounting positions, are incorpo-



"Light Ten" lathe announced by South Bend Lathe Works

To obtain additional information on equipment described on this page, see lower part of page 232.

rated in this machine. These heads have a mechanical electrical feeding mechanism embodying the use of a feed-screw. Change-gears are provided for varying the feed and spindle speeds. Lubrication is automatic. A special disk clutch on the screw feed has automatic throw-out in the event of overload. Dwell is accomplished by time relays. The design permits any combination of rapid traverse, feed, dwell, and rapid return. The cycling of the machine proper and the power heads is completely automatic. 67

Baker "Tru-Edge" Shear

Baker Brothers, Inc., 1000 Post St., Toledo 10, Ohio, have brought out a "Tru-Edge" shear which is capable of cutting irregular shapes in either mild or stainless steel sheets up to 3/16 inch thick. This machine is designed to meet the most exacting requirements, and will shear practically any material within its capacity, including mild steel, stainless steel, aluminum, brass, copper, and magnesium. An attachment for circle cutting and strip cutting is provided. The shear can also be used to cut to a scribed line or by templet.

With this machine, no starting hole is required for inside cuts. By simply substituting hammer type dies for the cutting tools, the machine can be adapted for beading and forming operations in steel up to 1/8 inch thick. The machine is designed to actually shear the metal, so that a smooth burr-free edge results, requiring no further finishing.

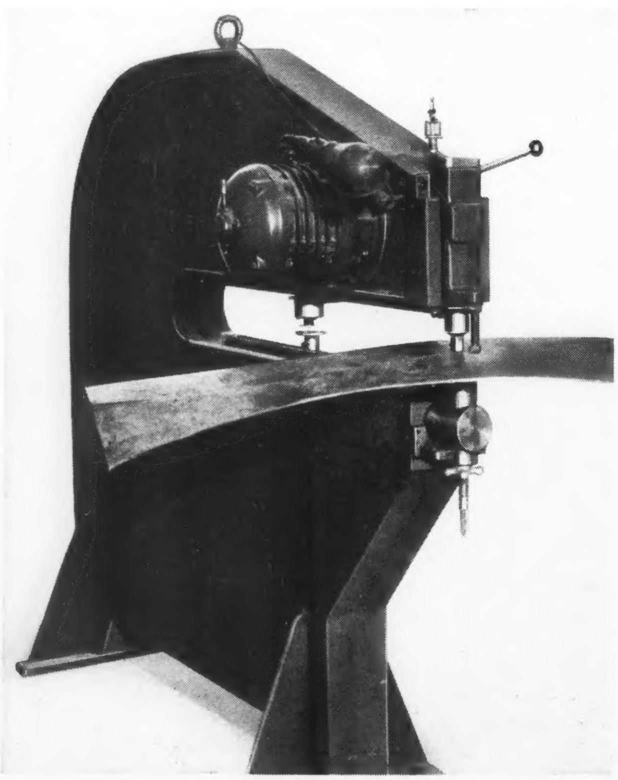
The new shear is made with a 48-inch throat; has variable stroke adjustment; and is driven by a 1 1/2-H.P., totally enclosed, ball-bearing motor. The only moving parts are one roll crank, two rollers, and top tool-holder. 68

Chambersburg "Cecostamp" Designed for Forming Large Sheet Metal Work

A new Model L "Cecostamp" announced by the Chambersburg Engineering Co., Chambersburg, Pa., uses impact blows of controlled intensities to produce a wide variety of metal shapes from any of the formable metals. It is 10 per cent more powerful than preceding "Cecostamps," and embodies many new features.

The control mechanisms are located in such a position that the operator is protected from moving parts. With the overhead safety rest control, both hands of the operator are occupied and cannot be accidentally placed under the die. Frame-to-anvil bolts and springs are recessed to avoid hazards to clothing. Positive self-positioning safety rests, built into the side frames between the guides, hold the ram when changing or servicing dies. Shock insulating features cushion vital parts. Automatic lubrication of valve cylinder and guides serves to prolong the life of these parts, the lubricator being turned on automatically when the machine starts.

This model "Cecostamp" is especially well adapted for the manufacture of bus and automobile bodies, sheet-metal aircraft parts, rail cars, home appliances, and numerous other products. 69



(Above) "Tru-Edge" shear placed on the market by Baker Brothers, Inc.

(Right) New "Cecostamp" for forming large work, built by Chambersburg Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 232.

Michigan "Shear-Speed" Machines for Cutting Internal Gears

The Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich., has announced the availability of its "Shear-Speed" line of machines for cutting internal spur gears, splines, and other miscellaneous forms. Almost any irregular shape can be cut, provided it lends itself to form-cutting with radially fed tools. The minimum inside diameter that can be handled is 5.4 inches, and the maximum approximately 20 inches.

In operation, the internal-gear "Shear-Speed" machines simply reverse the tool-feed action of the machines used for cutting external forms. Using two inverted cones, tools such as shown in the illustration are fed outward before each stroke of the reciprocating work and its holder. They are retracted slightly before the return stroke to prevent tool drag. Feed is decreased to finish-feed as proper depth of cut is approached. Two or three strokes at exact depth (without feed) are generally used to "clean up" before the head retracts and the machine stops for reloading. 70

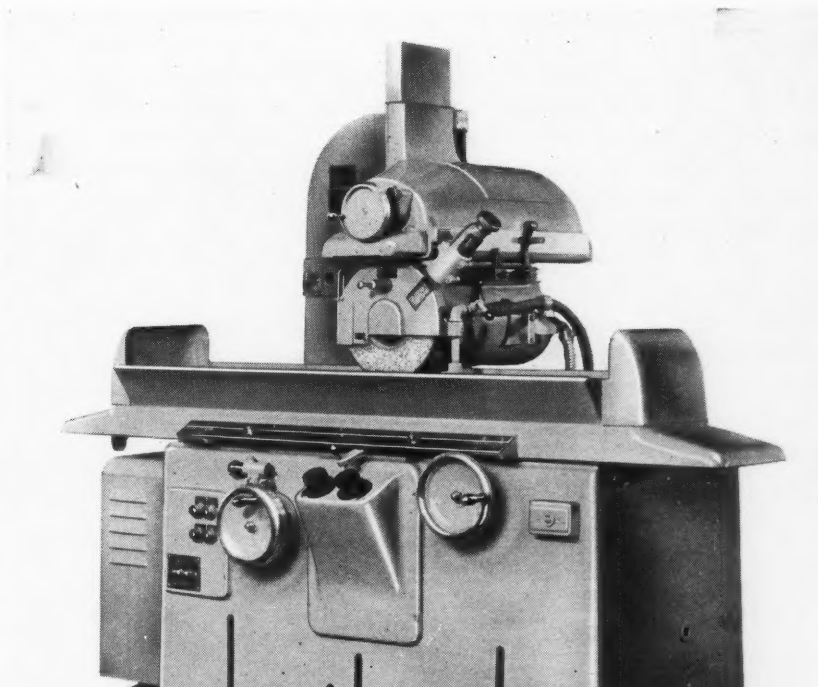
Typical tool-head with "single-point" form tools used on Michigan "Shear-Speed" machine for cutting an internal gear

Thompson Precision Tool-Room Grinder

The Thompson Grinder Co., Springfield, Ohio, has brought out a "super precision" Type 2F tool-room grinder in an 8- by 10- by 24-inch size in response to the demand for a larger machine of this type. The new grinder has all sliding bearings hardened and ground. Feed-screws are of the ground-thread type, and are extremely sensitive, being provided with anti-friction nuts.

The longitudinal work capacity is 24 inches, and the maximum table movement is 29 inches. Maximum vertical distance from table to under side of 12-inch wheel is 10 inches. The table has three 3/8-inch T-slots, and the working surface is 8 by 24 inches. The spindle is mounted in four permanently lubricated precision preloaded ball bearings.

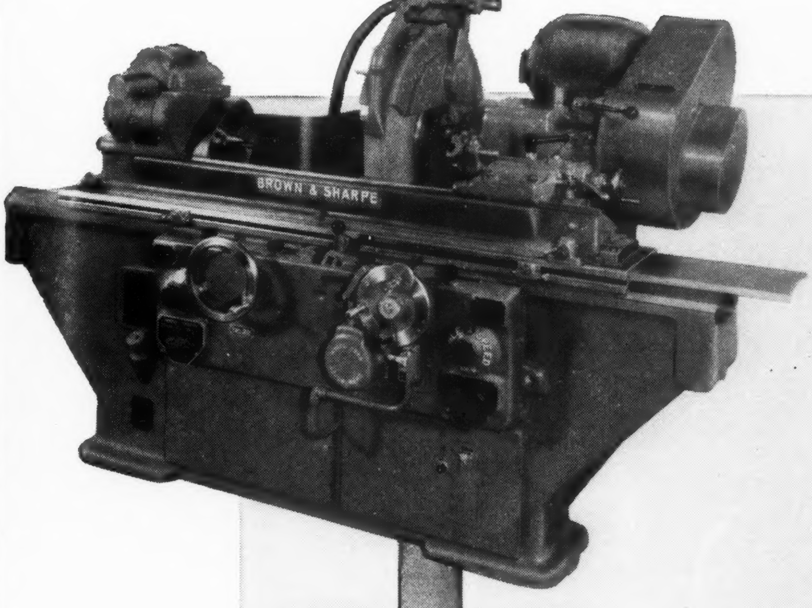
The wheel-head has speeds of 3600 and 1800 R.P.M., and the hydraulically operated table traverse speed is 5 to 70 feet per minute. Accurate vertical hand feeding is facilitated by 0.0005-inch graduations and micrometer positive stop graduated to 0.0001 inch. Hydraulic rapid traverse of cross-feed is 240 inches per minute. Hydraulic wheel truing speed is 6 inches per minute. Automatic hydraulic cross-feed is from 1/32 to 3/8 inch. Hydraulic and coolant pump drive is by a 1-H.P., 1145-R.P.M. motor. The machine weighs 3600 pounds. 71



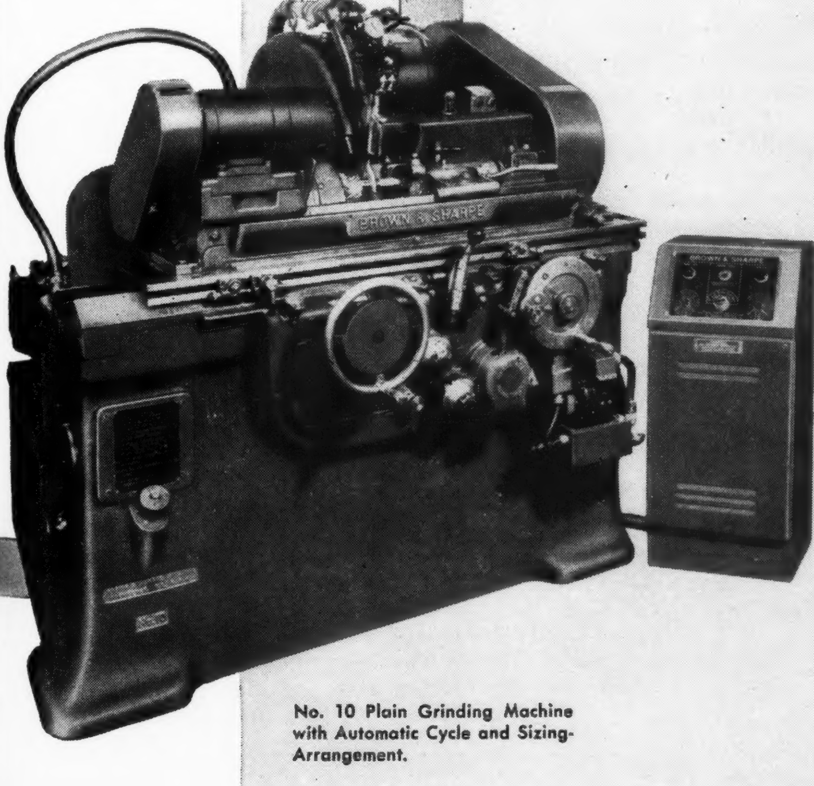
Precision tool-room grinder brought out by the Thompson Grinder Co.

To obtain additional information on equipment described on this page, see lower part of page 232.

NTS



No. 22 Plain Grinding Machine with Automatic Cycle and Spark-Timing Arrangement.



No. 10 Plain Grinding Machine with Automatic Cycle and Sizing-Arrangement.

AUTOMATIC CYCLE AND SPARK-TIMING ARRANGEMENT

On plunge-cut or transverse grinding where uniformity of sizing and finish is essential, this arrangement automatically controls spark time and operation at a predetermined rate (spark time adjustable from 2 to 180 seconds). After grinding is completed, wheel slide withdraws automatically, headstock stops and coolant is shut off. Arrangement used with reciprocating table employs normal amount of spark time allowed for traverse grinding without automatic cycle. Handwheel operation provides positive protection against automatic cycle starting accidentally.

AUTOMATIC CYCLE AND SIZING ARRANGEMENT

For longer production runs on plunge-cut grinding, where uniform sizing and finish to .0001" are desired, this arrangement offers maximum output at minimum cost and effort. It automatically sizes from the work—eliminates compensating for wheel wear and effects of wheel truing. After loading and three simple hand operations, cycle is completed automatically. When wheel approaches within .001" to .003" (pre-set on work sizing gage) of finish size, cycle changes from coarse feed to predetermined fine feed.

THESE TWO NEW ARRANGEMENTS NOW AVAILABLE on the following Brown & Sharpe Plain Grinding Machines: No. 5—Nos. 10 & 12—Nos. 20, 22 & 23.

SHARPE BS

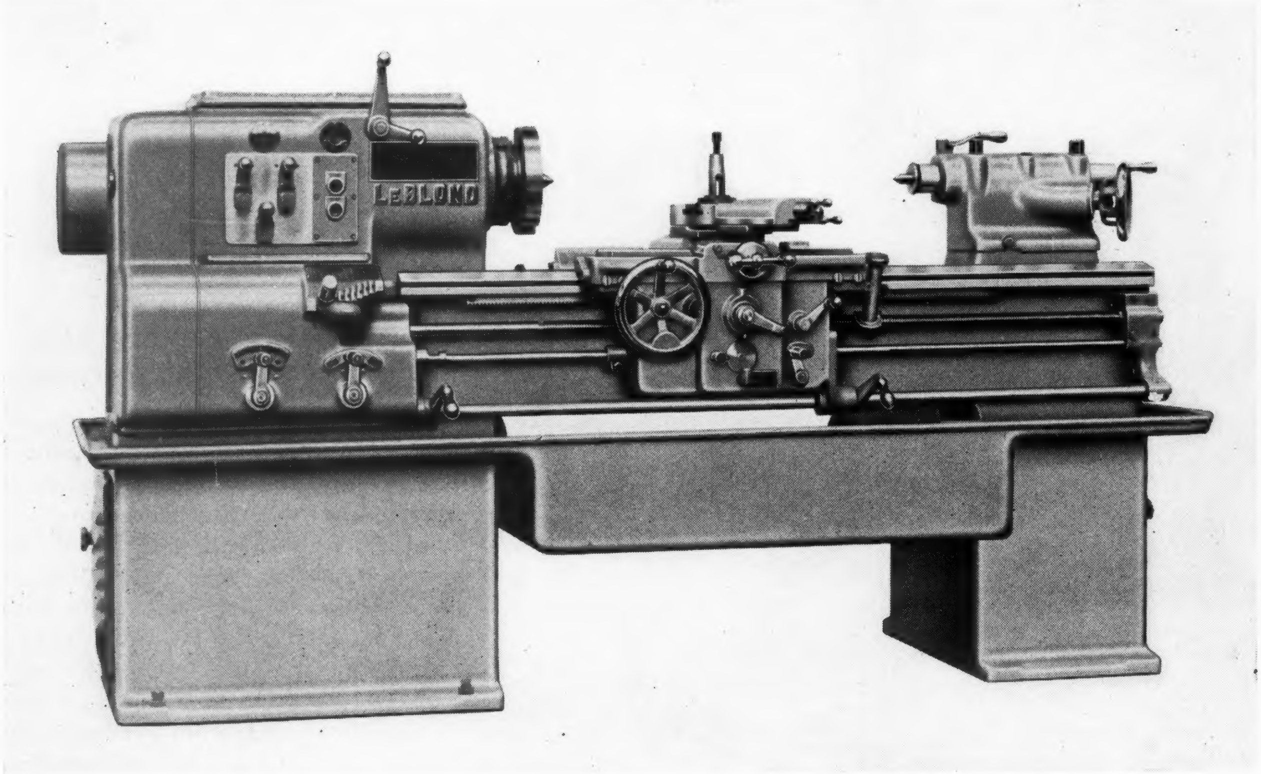


Fig. 1. Heavy-duty engine lathe built by the R. K. LeBlond Machine Tool Co.

LeBlond Heavy-Duty Engine Lathe

More and higher speeds are available in the new series heavy-duty engine lathes just announced by the R. K. LeBlond Machine Tool Co., Cincinnati 8, Ohio. This line of lathes includes 12-, 14-, and 16-inch swing sizes with twenty-four spindle speeds, and a 20-inch size with thirty-two spindle speeds. A maximum of 1250 R.P.M. is obtained in the 12- and 14-inch sizes.

The new lathes are designed for higher powered motors than previous models, the 12- and 14-inch sizes using a 7 1/2-H.P., 1800-R.P.M. motor; the 16-inch size a 10- or 15-H.P. 1800 R.P.M. motor; and the 20-inch size, a 15- or 20-H.P., 1200-R.P.M. motor.

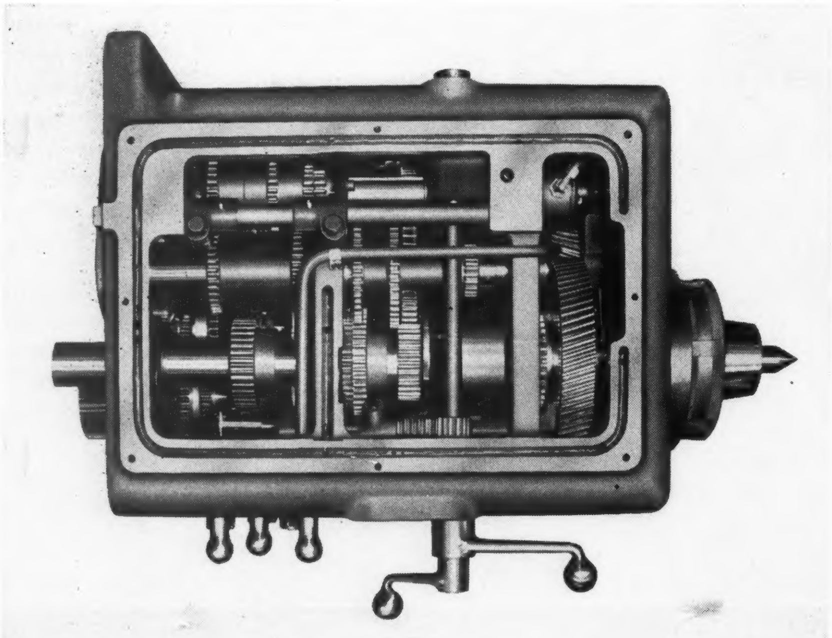


Fig. 2. Headstock incorporating free-running principle used on new line of LeBlond engine lathes

An enclosed automatically lubricated quick-change gear-box is incorporated in these lathes. Sixty feed and thread changes are obtained through hardened alloy steel gears. Shafts are supported on anti-friction bearings. The LeBlond compensating V-way principle has been retained in the bed, which is fitted with replaceable hardened and ground front and rear steel bed ways. The patented LeBlond apron and tailstock have also been retained. The apron is of one-piece construction, and is provided with positive jaw feed clutch and single-lever length and cross-feed control.

The heavy-duty line of engine lathes also includes four larger sizes (25-, 32-, 40-, and 50-inch), all of which are said to conform to the same basic design as the 14-inch size shown in Fig. 1. The headstock, shown in Fig. 2, that is used on these new lathes utilizes the LeBlond free-running principle in which any gears not actually in use are cut out of the gear train, so that they impose no load on the motor. 72

To obtain additional information on equipment described on this page, see lower part of page 232.

Cleveland Double-Action Toggle Press

The Cleveland Punch & Shear Works Co., Cleveland 14, Ohio, has brought out a new straight-sided, double-crank press. This toggle press is of the double-geared twin-drive type. It is equipped with a single-station electrically controlled, air-operated drum type friction clutch having a spring-loaded brake. The flywheel is arranged with an auxiliary air brake, and both the slide and the blank-holder are air-counterbalanced.

The inner slide has a stroke of 33 inches, and the outer or blank-holder slide a stroke of 22 inches. Both slides have an adjustment of 8 inches. The bed of the press is 60 by 96 inches. The capacity rating is 400 tons for the inner slide, and 250 tons for the blank-holder slide. This type of press can be furnished in a wide range of sizes and capacities. 73

"Rollon-Power" Stock Cradle

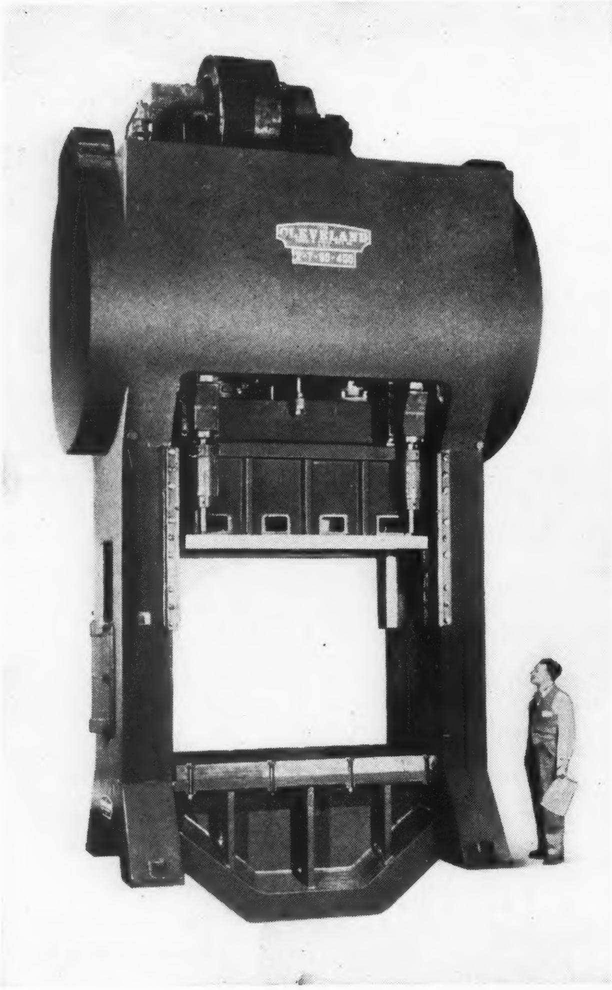
A "Rollon-Power" stock cradle designed to permit one man to roll heavy coils of strip stock into place on the power-driven rollers for feeding to a press has been placed on the market by the Medelton Co., Inc., 628 Westchester Ave., Bronx 55, N. Y. The separator plate on the cradle can be instantly adjusted for any width of coil within its capacity.

The slack loop is maintained automatically on any material, no more stock than needed being uncoiled. Elimination of stock drag serves to minimize operator fatigue and enable automatic feeds to operate with greater accuracy. The cradle will accommodate coils 10 inches wide by 36 inches in diameter weighing up to 800 pounds. The cradle is driven by a 1/4-H.P. motor. It is fabricated of 3/16-inch steel plate, and weighs 185 pounds. 74

Synchronized Concentric Lathe and "Auto-Drill"

A new production drilling machine in which the drill and the work are rotated simultaneously has been announced by the Auto Tool & Engineering Co., 2911 W. Armitage Ave., Chicago 47, Ill. It is claimed that this design makes it possible to drill holes in round parts that are concentric within 0.001 to 0.004 inch. This machine consists of a stand with a built-in coolant tank and pump; a bed; a variable-speed lathe head which provides work speeds from 200 to 3000 R.P.M.; and an "Auto-Drill" unit with "peck and drill" attachment incorporating rotating and reciprocating motions and which is adjustable for speed, depth, pressure, and dwell.

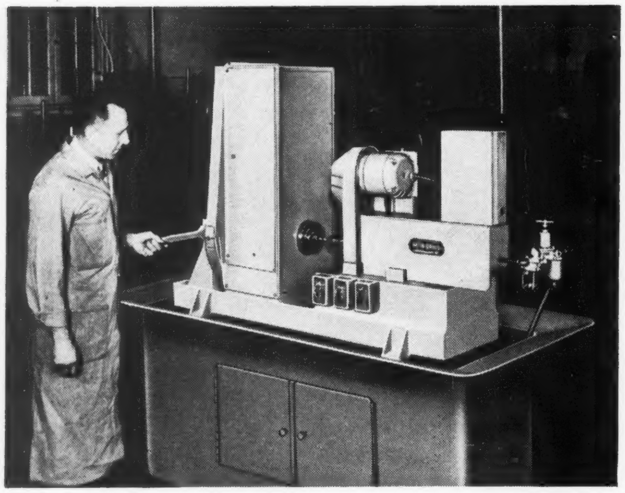
The "Auto-Drill" speed range for the "A" unit is 850 to 5000 R.P.M., the stroke length, 4 inches, and the pressure up to 500 pounds with an air operating pressure of



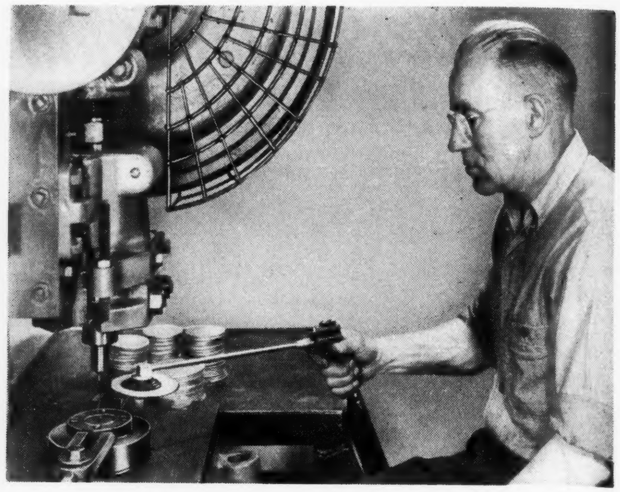
Double-action toggle press brought out by Cleveland Punch & Shear Works Co.

"Rollon-Power" stock cradle placed on the market by the Medelton Co., Inc.

To obtain additional information on equipment described on this page, see lower part of page 232.



Lathe for accurate concentric drilling of small round parts, brought out by Auto Tool & Engineering Co.



"Pres-Vac" safety feeder for hand-feeding small parts to press, made by the F. J. Littell Machine Co.

100 pounds per square inch. The "B" unit has a speed range of 375 to 3000 R.P.M., with a pressure up to 1000 pounds. These machines are semi-special and are made in two lathe head sizes.....75

Colonial "Flat-Top" Broaching Machine

A 4-ton "flat-top" broaching machine adapted for tool-room use is being manufactured by the Colonial Broach Co., Detroit 13, Mich. The flat top of this machine facilitates general short-run and miscellaneous broaching of both large and small parts without the use of special fixtures to support the work. The top surface of the table is 48 inches above the floor, and as there are no obstructions, heavy parts can be easily placed on the table or removed.

The particular machine shown in the illustration is set up for broaching elongated holes in broach bars. Other operations handled on this machine include slotting, keyway broaching, broaching irregular-shaped holes, and broaching operations on fixtures. 76

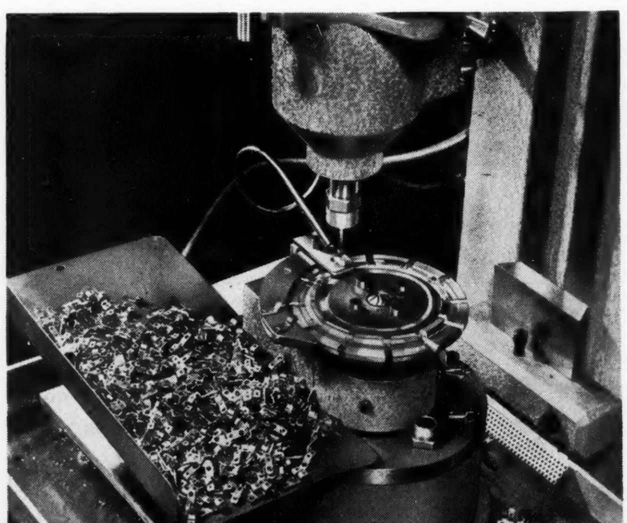
"Pres-Vac" Safety Feeder

The F. J. Littell Machine Co., 4149 N. Ravenswood Ave., Chicago, Ill., is manufacturing a device known as the "Pres-Vac" safety feeder, which permits hand-feeding of small parts into a press without requiring the operator's hands to enter the danger zone. The vacuum employed to pick up the parts is obtained by passing compressed air through a venturi tube. 77

Dial Indexing Fixtures

The Snow Mfg. Co., 435 Eastern Ave., Bellwood, Ill., has recently increased the versatility of its line of automatic and semi-automatic "Master" fixtures by the addition of several new features. A variety of dials and attachments can now be applied to

"Flat-top" tool-room broaching machine built by Colonial Broach Co.



Air-operated dial indexing fixture developed by the Snow Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 232.

the No. 14 horizontal indexing unit to adapt it for drilling, reaming, countersinking, and tapping operations. High production, quick, easy set-ups, and rapid loading and unloading are advantages claimed.

A wide range of small parts can be handled on this type of horizontal indexing fixture, including awkward stampings. The equipment is especially adapted for multi-hole drilling operations in small cylindrical pieces requiring accurate spacing of the holes in a circle. For work of this kind, the fixtures can be designed and tooled to allow one operator to feed three or four machines, it being merely necessary to insert the piece and start the drilling cycle, which stops automatically when all the holes are drilled. In the meantime, the operator is occupied in loading and unloading the other machines. 78

Leitz Optical Jig Borer

The George Scherr Co., Inc., 202 Lafayette St., New York 12, N. Y., has recently introduced in this country a Leitz optical jig borer of the design shown in the illustration. This machine is built for use on small work requiring the highest precision, the operating range being within an area of 6 by 6 inches. The setting of the longitudinal and transverse slides is effected by means of built-in illuminated precision glass scales which are read with a microscopic eye-piece having graduations of 0.00005 inch.

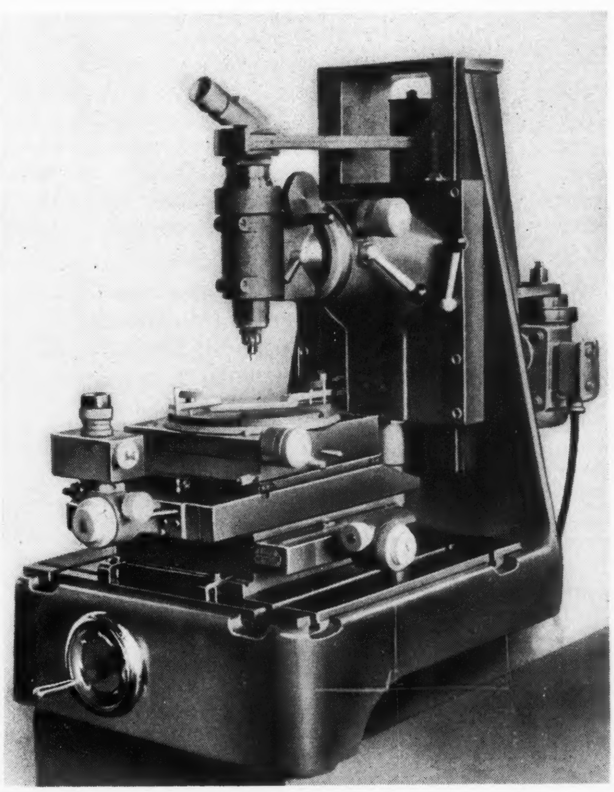
By simply shifting a lever, the operator can read both the length and crosswise measurements in the same eye-piece without changing his position. The glass scales have a coefficient of expansion corresponding closely to that of metal, and since the scales are only "viewed," they are not subject to wear and require on compensating devices. Work-pieces that differ in weight, as, for instance, a heavy steel body and a light-weight cover, can be machined successively with uniform accuracy, since the purely optical setting is not affected by any variations in pressure due to differences in the weight of the work.

The spindle is actually a combination drilling spindle and microscope. When the drill is removed, the microscope with concentric circles becomes operative. The work can thus be spotted, drilled, and inspected without removing it from the table.

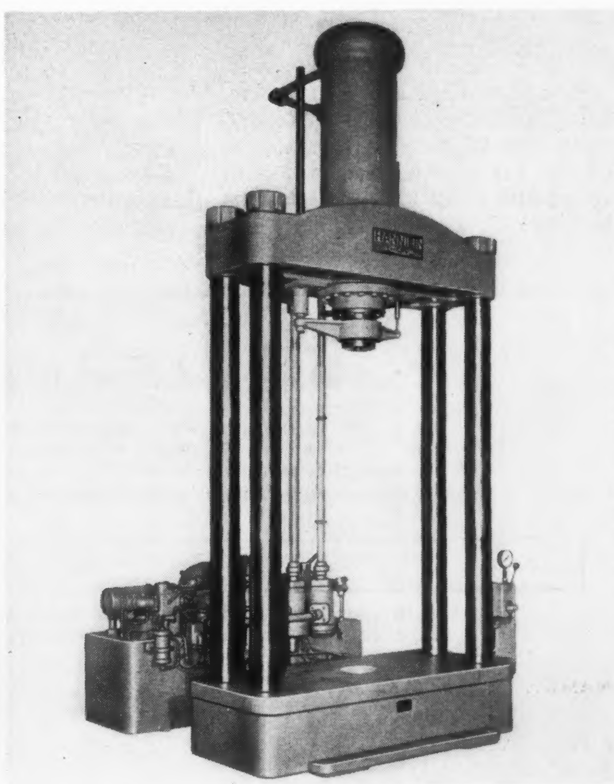
Flat drills are used for holes up to 1/8 inch in diameter, and an adjustable boring tool is furnished for larger holes—up to 1/2 inch in diameter. A spring-loaded scriber for lay-out work is part of the standard equipment. 79

Hannifin High-Speed Forcing Press

An unusually high ram speed for a 150-ton press—275 inches per minute maximum—is an outstanding feature of the new four-post hydraulic forcing press recently brought out by the Hannifin Corporation, 1110 S. Kilbourn Ave., Chicago 24, Ill. The press illustrated, which is used primarily for assembling shafts on armatures and rotors, has an 82-inch gap, with the ram up, and a 48-inch maximum stroke. The space between columns, left to right, is 60 inches, and front to back, 10 inches. The table, which is 36 inches deep, front to back, is 18 inches above the floor and has a 10-inch hole in the center to allow shafts to extend through.



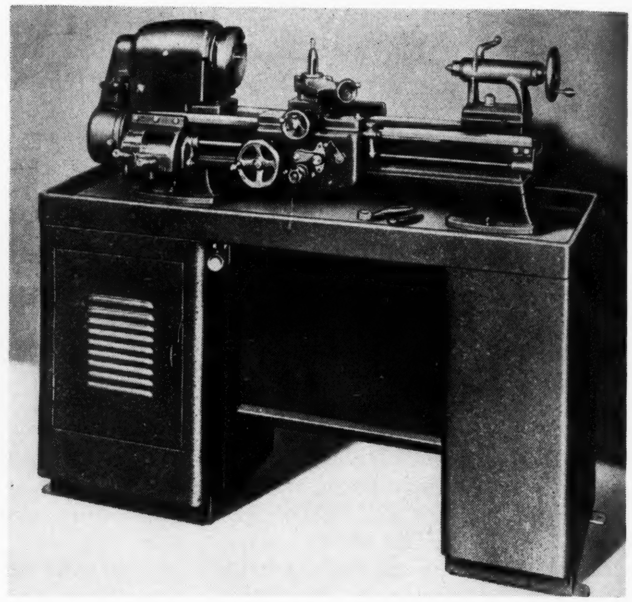
Leitz jig boring machine introduced by the George Scherr Co.



Hydraulic press for large press-fit work, built by Hannifin Corporation

To obtain additional information on equipment described on this page, see lower part of page 232.

Cut-off band saw manufactured by the Famco Machine Co.



Pedestal-base lathe brought out by Logan Engineering Co.

The Hannifin "sensitive pressure control" allows the operator to control accurately the amount of pressure applied. When a uniform pressure is to be applied repeatedly, a stop is provided to limit the travel of the control lever. The predetermined pressure thus obtained can be varied from 15 tons to the full capacity of 150 tons. 80

Famco Cut-Off Band Saw

The Famco Machine Co., Racine, Wis., has brought out a Model 612 metal cut-off band saw with capacity for cutting up to 6-inch round and 6- by 12-inch rectangular stock. It will accommodate any shape, and can be used for all kinds of metals. The 1/2-H.P. motor and Timken roller-bearing equipped transmission drive a 5/8-inch by 0.032-inch blade at cutting speeds of 50, 100, 175, and 300 feet per minute. The cooling system attachment can be installed in a matter of minutes. 81

Logan Lathe with Pedestal Base

A new 11-inch lathe with a 1-inch collet capacity, 1 3/8-inch spindle hole, and center distance of 24 or 36 inches, with adequate capacity for industrial work, as well as for maintenance shops, tool-rooms, and school shops, is being built by the Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill. The ball-bearing spindle permits speeds of 45 to 1500 R.P.M. without bearing adjustments. The bed ways are precision-ground to within 0.0005 inch of absolute lineal accuracy, and the total run-out of the spindle 12 inches from the front bearing is less than 0.0005 inch.

The lathe is mounted on a pedestal base, which completely encloses the drive. The new lathe is available in two models, which are identical in all respects except center distance, the No. 955 being 24 inches and the No. 957 36 inches between centers. 82

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described in this section is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in April, 1950, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on blank below. Detach and mail within three months of the date of this issue to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

NAME...POSITION OR TITLE.................................

[This service is for those in charge of shop and engineering work in manufacturing plants.]

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New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 238 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the April, 1950, Number of MACHINERY

Small Tools

WHITMAN & BARNES, 40600 Plymouth Road, Plymouth, Mich. General catalogue 102, illustrating and describing high-speed, carbon, and cobalt steel and tungsten-carbide drills and reamers, as well as carbon and high-speed steel interchangeable punches. Designed as an up-to-date reference guide for executives, engineers, tool supervisors, buyers, and distributors. Copies will be sent if requested on a business letter-head, addressed to the company.

Cold-Rolled Strip Steels

SANDVIK STEEL, INC., 111 Eighth Ave., New York 11, N. Y. Catalogue 50, covering the company's line of specialized spring steels, including 133 cold-rolled and unhardened sizes and 652 cold-rolled hardened and tempered sizes. Copies can be obtained if requested on a company letter-head addressed directly to Sandvik Steel, Inc.

Motor Controls

ALLEN-BRADLEY CO., 136 W. Greenfield Ave., Milwaukee 4, Wis. Reference book containing seventy-six pages of information, including dimensions and prices, of the company's line of modern motor controls. Copies can be obtained if requested on a business letter-head directed to the company.

Gear-Hobbing Machines

GOULD & EBERHARDT, INC., Irvington 11, N. J. Catalogue 233, illustrating the latest additions to the line of Gould & Eberhardt universal manufacturing gear-hobbing machines. Copies will be sent to those interested if requested on business stationery addressed directly to the company.

Steels for Elevated Temperatures

UNITED STATES STEEL CORPORATION, 429 Fourth Ave., Pittsburgh 19, Pa. Publication containing eighty-seven pages of information on steels for elevated temperature service, for the use of engineers, chemists, and metallurgists in the power, transportation, and chemical process industries, as well as those interested in the design of jet engines, rockets, and gas turbines. The booklet provides both tabular and graphic data on the mechanical properties of twenty-one different steels with a variety of chemical compositions. 1

Steel Castings

NATIONAL ERIE CORPORATION, Erie, Pa. Catalogue showing the successive steps in the production of "Neloy" steel castings, made for use where machinability, toughness, strength, hardness, and resistance to shock and wear are important. Tables of analysis and physical properties are included. The machine shop where cut gears are produced and other castings machined is also shown. 2

Gages

CADILLAC GAGE CO., 20316 Hoover Road, Detroit 5, Mich. Catalogue covering the entire range of gages manufactured by the company, including thread plug and ring gages, concentricity gages, pipe thread gages, adjustable snap gages, and special gages. Charts give information on the use of these products. 3

Broaches

AMERICAN BROACH & MACHINE CO., Ann Arbor, Mich. Catalogue 450, containing complete information on the various types of broaches manufactured by the company, including internal and surface broaches, as well as broach-holders and pull and push broach heads. Specific applications are illustrated. 4

Steel Casting Charts

LEBANON STEEL FOUNDRY, Lebanon, Pa. Steel casting reference charts, covering thirty-three grades of carbon and low-alloy, stainless, and corrosion- and heat-resistant steels, including designations, analyses, physical properties, heat-treatment, and related data. 5

Automatic Finishing Machines

HAMMOND MACHINERY BUILDERS, INC., 1614 Douglas Ave., Kalamazoo, Mich. Catalogue 50, describing the company's line of indexing and continuous rotary automatic polishing and buffing machines, as well as the "Strait Line" automatic built to suit individual applications. 6

Alloy Plate Fabrication

NOOTER CORPORATION, 1400 S. 2nd St., St. Louis 4, Mo. Catalogue entitled "Beyond Your Blueprints," illustrating the fabrication of steel and alloy tanks and pressure vessels for various industries. Corrosion data charts are included. 7

Sealing and Bonding Process

WESTERN SEALANT, INC., 9042-48 Culver Blvd., Culver City, Calif.

Folder descriptive of the company's mechanical impregnation and bonding process for preventing porosity in castings and for bonding materials to each other. ... 8

Universal Fixtures for Precision Boring Machines

EX-CELL-O CORPORATION, 1200 Oakman Blvd., Detroit 32, Mich. Bulletin 31101, illustrating and describing manually and hydraulically operated fixtures designed for use on all styles of Ex-Cell-O precision boring machines. ... 9

Bakelite Products

BAKELITE DIVISION, UNION CARBIDE AND CARBON CORPORATION, 30 E. 42nd St., New York 17, N. Y. Anniversary issue of "Bakelite Review," describing and illustrating the story of Bakelite's forty years of progress in the plastics industry. ... 10

Welded Steel Fabrication

E. W. BLISS CO., Rolling Mill Division, Salem, Ohio. Circular describing the company's manufacturing facilities for the contract production of welded steel parts, such as gear blanks, machine components, special structural shapes, etc. ... 11

Stamping Trimmers

WHITING CORPORATION, Harvey, Ill. Bulletin QW-123, on the "Quickwork" Whiting stamping trimmer, illustrating by line drawings and photographs the wide range of trimming, beading, and forming operations performed on this machine. ... 12

Arc-Welding Machines

AIR REDUCTION SALES CO., 60 E. 42nd St., New York 17, N. Y. 36-page catalogue, covering all the machines in the Airco arc-welding machine line, which includes both alternating- and direct-current machines. ... 13

Bench Type Power Press

KLAAS MACHINE & MFG. CO., 4314 E. 49th St., Cleveland 9, Ohio. Circular illustrating and describing the Emco bench type power punch press, designed to meet requirements for increased production at less cost. ... 14

Alloy-Steel Reference Chart

COOPER ALLOY FOUNDRY CO., Hillside 5, N. J. Reference chart, containing a comprehensive analysis of stainless and corrosion- and heat-resistant alloy castings, giving designations, properties, analyses, and applications. ... 15

Hollow Mills

RELTOOL CORPORATION, 4540 W. Burnham St., Milwaukee 14, Wis. Catalogue 50, announcing a new series of high-speed steel hollow mills, designed in two types for milling steel and brass or other non-ferrous metals. ... 16

Air-Powered Rotary-Feed Table

BELLOWS CO., 222 W. Market St., Akron, Ohio. Bulletin T-25, containing detailed information on the Bellows air-powered rotary feed table for feeding work-pieces to machine tools. ... 17

Carbide-Tipped Tools

CORUNDUM CO., INC., Department I, 1777 E. 87th St., Cleveland 6, Ohio. Bulletin describing the company's line of tungsten-carbide and cast-alloy tipped tools, including a new lower price schedule. ... 18

Bronze Bars and Bearings

BUCKEYE BRASS & MFG. CO., 6410 Hawthorne Ave., Cleveland 3, Ohio. Pocket size catalogue No. 480, listing Buckeye fully machined bronze maintenance bars, solid maintenance bars, and sleeve type bronze bearings. ... 19

Milling Cutters

McCROSKY TOOL CORPORATION, Meadville, Pa. Bulletin 17-M, describing the features of construction of "Jack-Lock" milling cutters equipped with carbide-tipped, cast-alloy, or high-speed steel blades. ... 20

Stamping and Metal-Working

CHARLES T. BRANDT, INC., 1700 Ridgely St., Baltimore 30, Md. File folder containing an analysis of the stamping and metal-working facilities of the company, for the use of estimators and engineers. ... 21

Welding Rods and Fluxes

ALL-STATE WELDING ALLOYS CO., INC., 273 Ferris Ave., White Plains, N. Y. Pocket-size booklet containing complete data on All-State low-temperature welding and brazing rods and fluxes. ... 22

Automatic Centering Reels

F. J. LITTELL MACHINE CO., 4149 N. Ravenswood, Chicago 13, Ill. Circular (Section 5EE), describing the company's standard line of automatic centering reels for holding coils weighing from 300 to 6000 pounds. ... 23

Beryllium-Copper Strip and Wire

BERYLLIUM CORPORATION, Reading, Pa. Bulletins 12 and 13, containing information on how to order beryllium-copper strip, and beryllium-copper rod, bar, and wire, respectively. ... 24

"Pull-Push" Rule

STANLEY TOOLS, DIVISION OF THE STANLEY WORKS, New Britain, Conn. Leaflet descriptive of the Defiance "pull-push" steel "tape-measure type" rule for making both inside and outside measurements. ... 25

Machine Tool Lubricants

SUN OIL CO., 1608 Walnut St., Philadelphia 3, Pa. Booklet outlining the development of Sunoco machine tool way lubricant, and presenting case histories on its use. ... 26

Welding Machines

WESTINGHOUSE ELECTRIC CORPORATION, Box 2099, Pittsburgh 30, Pa. Booklet DB 26-100, describing the company's new selenium-rectifier direct-current welding machines. ... 27

Horizontal Boring Mills

CINCINNATI GILBERT MACHINE TOOL CO., Cincinnati, Ohio. Catalogue entitled "Performance Counts," illustrating unusual operations performed on Gilbert horizontal boring mills. ... 28

Riveted Roller-Chain Assembly

CHAIN BELT CO., 1600 W. Bruce St., Milwaukee 4, Wis. Bulletin 50-6, illustrating and describing the Baldwin-Rex "BA" riveted roller-chain assembly. ... 29

Electrodes

HOBART BROTHERS CO., Troy, Ohio. Catalogue containing a description of Hobart electrodes, together with data on mechanical properties, applications, and welding procedure. ... 30

Bending Presses

CLEVELAND CRANE & ENGINEERING CO., 1042 E. 289th St., Wickliffe, Ohio. Catalogue 2010-E, giving construction details and specifications for the Steelweld line of bending presses. 31

Power Tools

WALKER - TURNER DIVISION, KEARNEY & TRECKER CORPORATION, Plainfield, N. J. Catalogue A, containing 36 pages of data on Walker-Turner power tools for metal, wood, and plastics. 32

Rotary Files

R. G. HASKINS CO., 2651 W. Harrison St., Chicago 12, Ill. Bulletin RF-50, containing complete data on Haskins "Fifty-to-One" carbide rotary files and ground cutters. 33

Socket Screws

PARKER - KALON CORPORATION, 200 Varick St., New York 14, N. Y. Bulletin 490, containing engineering data on the various types of Parker - Kalon socket screws. 34

Bandsaw Wheel Tires

CARTER PRODUCTS CO., Grand Rapids, Mich. Folder on company's new "Jiffy-Tire" for bandsaw wheels, designed for rapid application without cement, glue, or special tools. 35

High-Speed Motors

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Bulletin GEA-5426, on "Tri-Clad" high-speed synchronous motors and their applications. 36

Micrometers

L. S. STARRETT CO., Athol, Mass. Bulletin illustrating and describing the important new features of the Starrett line of satin-chrome finish micrometers. 37

Hydraulic Arbor Presses

K. R. WILSON, 215 Main St., Buffalo 3, N. Y. Circular illustrating and describing hand-operated and air-oil-operated hydraulic arbor presses. 38

Lock-Nuts

PALNUT CO., 61 Cordier St., Irvington 11, N. J. Folder containing two case histories typical of the performance of Palnut self-locking nuts. 39

Flash Butt-Welding

AMERICAN WELDING & MFG. CO., Warren, Ohio. Booklet illustrating and describing typical applications of flash butt-welding on a variety of products. 40

Gear-Motors

JANETTE MFG. CO., 556 W. Monroe St., Chicago 6, Ill. Bulletin 3-100, illustrating and describing fractional and integral gear-motors. 41

Pre-Formed Solder Shapes

SOLDERING SPECIALTIES, Summit, N. J. Bulletin entitled "How to Speed Up Soldered Assemblies with Solder Pre-Forms. 42

Self-Lubricating Packings

GREENE, TWEED & CO., North Wales, Pa. Bulletin LP-10, on Palmetto self-lubricating packings for all industrial services. 43

B. C. Ames Co. Celebrates Golden Anniversary

The B. C. Ames Co., Waltham, Mass., a leading manufacturer of micrometer dial indicators and gages, is celebrating its fiftieth anniversary this year. Bliss Charles Ames founded the company in Waltham, starting with Mrs. Ames as office manager and one apprentice. The company expanded rapidly as its precision machinery and instruments became known both in this country and abroad.

In 1915, due to the expansion caused by World War I, Mr. Ames's two sons, Warren and Ira R., were taken into the company and operated the plant until its incorporation in 1922. The father retired in 1923 and his interest in the company was bought by the sons. In 1946, the machine tool division was sold to Ira Ames, and Warren Ames, the present president, took over as owner of the B. C. Ames Co.

* * *

Bulletin on Gray Iron Specifications Available

A revised summary of gray iron specifications is being distributed by the Gray Iron Founders' Society. The four-page bulletin contains the provisions of fourteen separate sets of gray iron specifications, including two new specifications covering automotive irons for brake drums and clutch plates. Single copies are available at no charge from the Gray Iron Founders' Society, Inc., 210 National City, E. 6th Bldg., Cleveland 14, Ohio.

To Obtain Copies of New Trade Literature

listed in this section (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail within three months of the date of this issue (April, 1950) to MACHINERY, 148 Lafayette Street, New York 13, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

NAME...POSITION OR TITLE.................................

[This service is for those in charge of shop and engineering work in manufacturing plants.]

FIRM...

BUSINESS ADDRESS..

CITY...STATE..

By E. S. Salichs

BETWEEN GRINDS

Banning the Boner

Having to do with the printed word, we were naturally interested in an anecdote presented in the "Times Book Review" describing a stern martial approach towards the printer's gremlins which pop up to the chagrin of the publisher. Seems the editor of the "Marine Corps Gazette" captioned a picture "Marines Swam Ashore," incurring the wrath of his commanding general, who argued that the Marines would have drowned swimming ashore in battle dress. The editor pointed out that the caption should have read "Marines Swarm Ashore." The next morning he received a written order from the general: "In the future, there will be no more typographical errors in the Marine Corps Gazette."

Love That Machine

The Cadillac "45" hydraulic marking machine on exhibit April 10 to 14 (Booth 753) at the ASTE Exposition in Philly, according to an advance release "gives impressions from those as gentle as a 'kiss' to the crushing force of 12,000 pounds pressure, delivering an unfaltering flow of power for every conceivable marking requirement."

A Broach's Life is a Cutting One

"Big Boy," the world's largest broach, hits stardom in a 16-millimeter color film (produced through the cooperation of Detroit Broach Co., Commercial Steel Treating Corporation, Eaton Mfg. Co., and Universal-Cyclops Steel Corporation) that traces the story of his life. The film starts with the pouring of the steel for his forging and reaches its climax as Big Boy, now an involute spline broach weighing over 1/2 ton, goes into production by removing 2 1/4 pounds of steel on his every stroke. There is no stopping Big Boy then as he breaks all records, slashing tool and maintenance costs and reducing production time. If you are an interested group who would like to see Big Boy in action, just contact the Detroit Broach Co., 20201 Sherwood, Detroit 34, Mich., and avail yourselves of the film without charge.

Professor Draws Blank

A professor from Iowa State College who is compiling an anthology of outstanding book dedications and epigraphs asked us, as book publishers, to submit any unusual ones we may have used. We don't. Perhaps we could slip a dedication into the next book we publish, something like this:

To the designer, draftsman, engineer
Whose ingenuity knows no frontier!

Or how about a narrative poem beginning:

'Twas in the year forty-nine
When first I met cosine

Oy Means Incorporated

A Finnish firm, Tarvike-Keskus Oy, wrote to us for information. They operate on Arkadiankatu Street in Helsinki.

Mind Your Smoking Manners

"Many buyers say their biggest objections to salesmen are their poor smoking habits." So *Printers Ink* outlines a few types:

Steam engine—camouflages both himself and sample case with smoke

Gangster—dangles cigarette from corner of mouth

Moocher — "gotta match" or "gimme a cig"

O.P.B. criticizer—criticizes other people's brands

Basketball player—flips butts through window, or at wastebasket

Coffee cup crusher—too much effort to reach ash tray

Tightwad—extracts one cigarette from his pack in pocket; offers cheap cigars

Smudge-pot—leaves smoldering cigarette behind

Nicotine fit—During tension of sale, gets fidgety and searches for cigarette

Tool Engineers Make Webster's

A concise definition included in the New Collegiate Dictionary now simplifies the tool engineer's response should he find himself, for instance, on the radio confronted by the question "And so you're a tool engineer—just what do you do?" Glibly he now may quote Webster: "Tool engineers are the men in industry whose function is to (a) plan the process of manufacture (b) supply the tools and (c) integrate the facilities required for producing given products—with minimum expenditure of time, labor and materials."

News of the Industry

California, Washington, and Texas

O'Brien Industrial Equipment Co., 1295 Folsom St., San Francisco, Calif., has been appointed sales representative for the Eriez Mfg. Co., Erie, Pa., manufacturer of magnetic equipment.

C. L. Stocker, 1303 Stanford Ave., Emeryville, Calif., has assumed sales and engineering responsibilities for the Lincoln Electric Co., Cleveland, Ohio, in the San Francisco area. A. L. Patnik has been given charge of welding engineering in the Seattle district, with offices at 1914 Utah Ave., Seattle, Wash.

Carborundum Co., Niagara Falls, N. Y., announces that production has been started on Carborundum silicon carbide in a new plant in Vancouver, Wash. This plant, which was erected at a cost of over two million dollars, is located on a 99-acre site. Plant lay-out is designed to permit continuous material flow. J. L. Bergman is superintendent of the new plant, and A. C. Knapp plant engineer.

Machinery Sales & Engineering Co. has moved from 508 Pinckney St. to 21 Nolan St., Houston 3, Tex.

Illinois and Indiana

Harry R. Nelson, for the last twenty years vice-president, secretary, and general manager of the Charles L. Anderson Machinery Co., Chicago, Ill., jobbing machine shop, has resigned to take a well earned rest. Mr. Nelson has been connected with the tool and die business for thirty-six years. He is a member of the American Society of Tool Engineers, and is at present serving as a member of the National Finance Committee.

Robert F. Dick has been appointed administrative assistant to Calmer F. Johnson, vice-president and treasurer of the Illinois Tool Works, Chicago, Ill., manufacturers of metal-cutting tools and machines and metal-fastening devices. Before joining the company, Mr. Dick was, for ten years, a vice-president of George Fry & Associates, consulting management engineers, with offices in Chicago and New York.

Carl L. Sadler, Jr., has been appointed chief engineer of the Hydraulic Division of the Sundstrand Machine Tool Co., Rockford, Ill., after having served as assistant chief engineer for the last two years. Prior to this, Mr. Sadler was a group engineer in the Aviation Gas Turbine Division of the Westinghouse Electric Corporation in Philadelphia.

W. M. Hurley, formerly assistant works manager of the East Alton, Ill., plant of Olin Industries, Inc., has been promoted to the position of works manager. Mr. Hurley succeeds B. E. Rogers, who recently became works manager of the Winchester Repeating Arms Co., Division of Olin Industries, Inc., New Haven, Conn.

T. R. Farley, vice-president of the Caterpillar Tractor Co., Peoria, Ill., has been made general manager of the company's new plant near Joliet, Ill.

William B. McFerrin has been appointed executive vice-president of the Haynes Stellite Division, Union Carbide and Carbon Corporation, Kokomo, Ind., and Robert M. Briney has been made vice-president in charge of wrought-alloy products. Prior to their present appointments, Mr. McFerrin had been assistant manager of development for the Electro Metallurgical Division in Detroit, while Mr. Briney had been manager of the Development Division, Union Carbide and Carbon Research Laboratories, Inc., of New York.

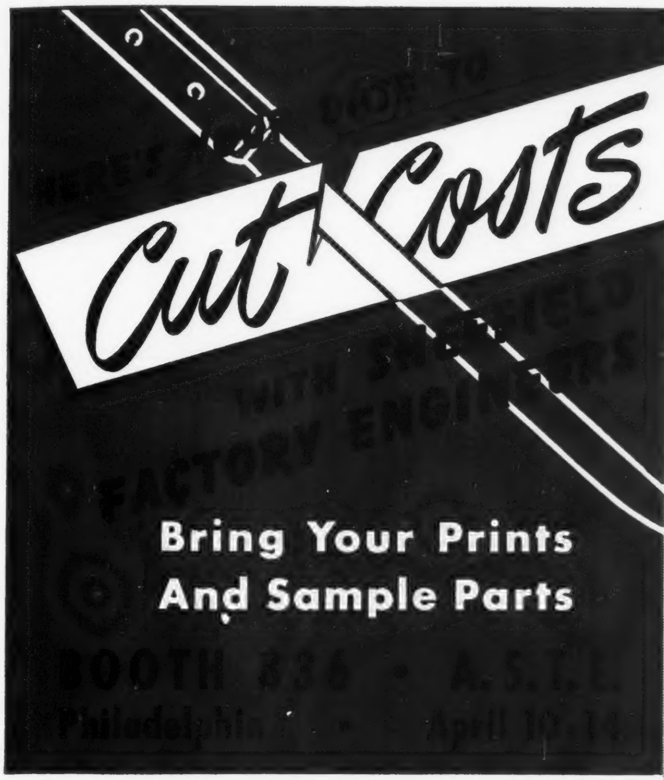
Michigan and Wisconsin

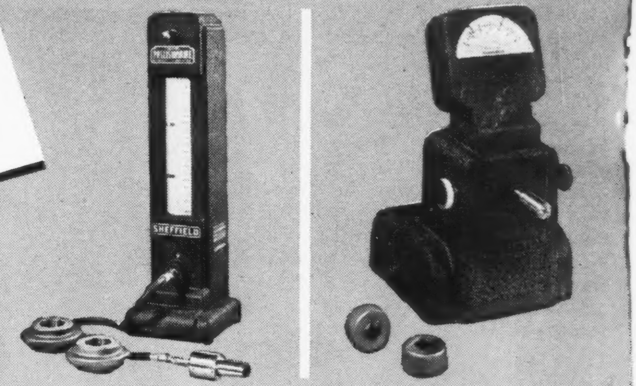
Prozite Co. has been formed at Calumet, Mich., by Poor & Co. of Chicago, Ill., and Calumet & Hecla Consolidated Copper Co., Calumet, to market a new line of buffing and polishing compositions. The recently formed company has appointed the Gerity-Michigan Corporation, Adrian, Mich., its exclusive national sales agent. A. L. Pietrowicz, formerly vice-president of the Chicago Plating Co., is sales manager of the Prozite Co.

Tom J. Rutledge and Roy E. Charbonneau have been appointed sales representatives for the forging machines made by the Hill Acme Co., Cleveland, Ohio. They have their headquarters at 335 Curtis Bldg., Detroit 2, Mich.

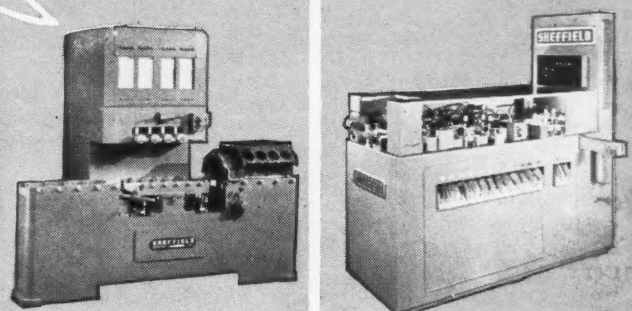
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., announces that all operations of the Cincinnati Planer Co. now functioning at Cincinnati, Ohio, will be moved to Fond du Lac and consolidated with the parent organization in order to reduce general operating costs and provide more extensive engineering and research facilities. The complete machine tool line heretofore manufactured in Cincinnati will now be built in modern buildings especially designed for machine tool manufacturing and recently acquired by Giddings & Lewis. There will be no interruption in the delivery of the Cin-

(Left) William B. McFerrin executive vice-president of Haynes Stellite Division, Union Carbide and Carbon Corporation. (Right) Robert M. Briney, vice-president in charge of wrought-alloy products, Haynes Stellite Division

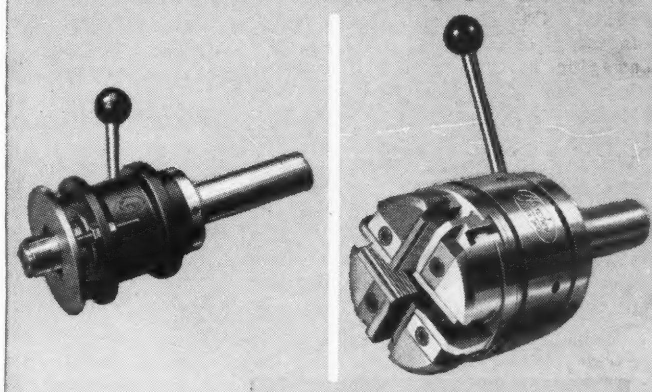




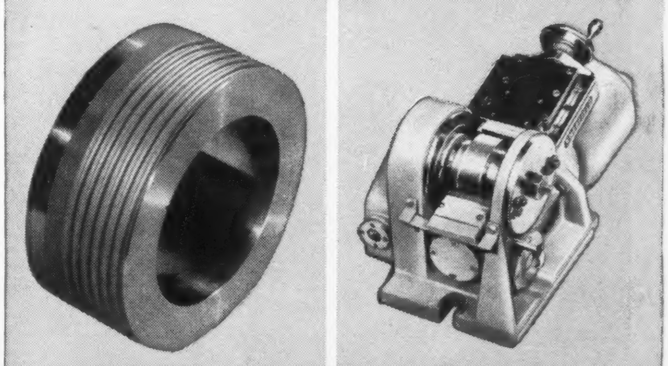
Cut Gaging Costs With Precisionaires And Other Sheffield Gages



Lowest Cost Inspection With Sheffield Automatic Gaging



Lower Cost Per Thread With Murchey Threading Tools



Cut Grinding Costs With Sheffield Crushtrue Rolls, Devices and Grinders

Make your attendance pay off at the A.S.T.E. Philadelphia Exposition by a *"cost-cutting" consultation with Sheffield Factory Engineers.*

Learn how costs can be cut in Gaging, Grinding, Gear Burring, Chamfering and Burnishing, Threading, Dies, Tooling, Contract Engineering and Manufacturing.

You will see many new and advanced Sheffield "Cost-Cutting" products in action—you can learn how they may be applied in *your plant to reduce your costs.*

Bring your prints and sample parts. By working and sketching together, recommended solutions and complete specifications, in many cases, can be given right on the spot.

If you don't go to Philadelphia, bring or mail your prints to Dayton for "cost-cutting" consultation or recommendation.

the Sheffield corporation
Dayton 1, Ohio, U.S.A.

MASTER CRAFTSMEN SHEFFIELD HEADQUARTERS

BOOTH 836 The Center of The Show Where The Two Main Aisles Meet

5496

cinnati "Hypro" line during the removal, which is expected to be completed by July 1.

New England

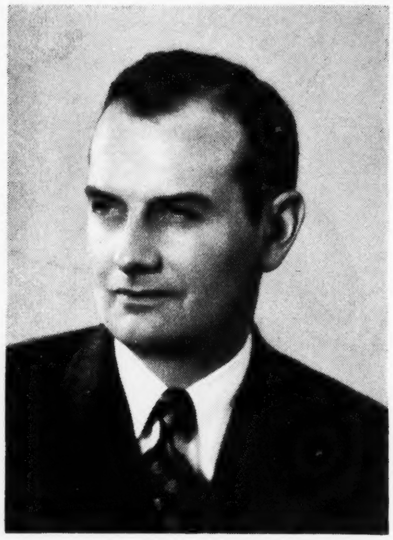
. EDWARD C. MANIX has been appointed manager of the South Deerfield, Mass., branch of the Nichols Wire & Aluminum Co. Mr. Manix was formerly manager and treasurer of the Arms Mfg. Co., also of South Deerfield.

NEW BRITAIN-GRIDLEY DIVISION OF THE NEW BRITAIN MACHINE CO., New Britain, Conn., announces the appointment of EINO HILL as a representative of the company in the Chicago territory, complementing the duties of JACK BARRY, who has been Chicago representative for many years. Announcement has also been made of the addition of GUS GRAN to the company's Detroit office.

BERTON E. ROGERS has been appointed works manager of the Winchester Repeating Arms Co. Division of Olin Industries, Inc., New Haven, Conn. Mr. Rogers was formerly works manager of the Olin plant in East Alton, Ill.

ROBERT P. MERRITT has been elected president of the Hartford Special Machinery Co., Hartford, Conn., manufacturer of drilling, tapping, and swaging machinery and thread-rolling and die-polishing machines. ERNEST W. SMITH, JR., has been elected executive vice-president, and WILLIAM H. STORRS, vice-president in charge of engineering. Mr. Merritt has been with the company since his graduation from Williams College in 1933. He succeeds his father, the late Joseph Merritt, one of the founders of the company.

Arthur L. Fleck, recently appointed general sales manager, American Screw Co.



© Jean Raeburn, N. Y.

Bernard Dolan, newly appointed manager of sales for Peter A. Frasse & Co., Inc.

ARTHUR L. FLECK has been appointed general sales manager of the American Screw Co., Providence, R. I., succeeding the late Charles O. Drayton. Mr. Fleck was assistant to Mr. Drayton for many years. He has served as manager of the company's Chicago office and warehouse for the last ten years.

New York and New Jersey

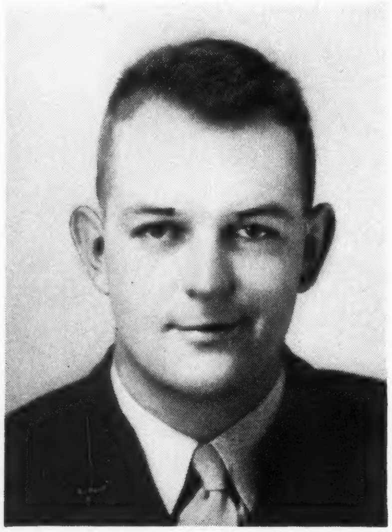
BERNARD DOLAN, formerly manager of merchandising for Peter A. Frasse & Co., Inc., 17 Grand St., New York 13, N. Y., has been appointed manager of sales. In addition to having charge of sales in the New York, New Jersey, and Connecticut areas, he will continue to direct the company's advertising and sales promotion activities. Mr. Dolan is president of the National Industrial Advertisers Association.

E. W. BLISS CO., Toledo, Ohio, has appointed the WEGNER MACHINERY CORPORATION, 35-41 Eleventh St. Long Island City, N. Y., exclusive representative for the company's line of mechanical and hydraulic presses in southeastern New York, the northern half of New Jersey, and northeastern Pennsylvania. Bliss presses and replacement parts will be carried in stock by the new agent.

F. J. MCNIFF has joined the Crucible Steel Co. of America, 405 Lexington Ave., New York City, as representative of the stainless steel sales department in the Atlantic seaboard region and metropolitan New York. Mr. McNiff had been connected for seventeen years previously with Industrial Steels, Inc., Cambridge, Mass., in operating and sales management work.

CRUCIBLE STEEL CO. OF AMERICA has moved its tool steel sales headquarters from New York City to the Sanderson-Halcomb Works in Syracuse, N. Y. This move will centralize and combine the tool steel sales division with the production, research, and development departments in the newly enlarged and modernized Sanderson-Halcomb plant.

NATIONAL ROLLED THREAD DIE CO., Cleveland, Ohio, has appointed L. C. BIGELOW & CO., INC., 250 W. 54th St., New York City, representative in metropolitan New York and the western half of Connecticut for the sale of National "Super" thread rolling dies.



(Left) Robert P. Merritt, newly elected president of the Hartford Special Machinery Co. (Right) Ernest W. Smith, Jr., executive vice-president

(Left) Ernest R. Baxter, recently appointed assistant vice-president of the Carborundum Co. (Center) Frederick W. Bonacker, new general sales manager. (Right) Fred W. Scott, Jr., sales manager of Coated Products Division

CARBORUNDUM Co., Niagara Falls, N. Y., has announced the following executive promotions: ERNEST R. BAXTER, formerly director of sales and sales administration, has been made assistant vice-president; FREDERICK W. BONACKER, sales manager of the Coated Products Division, becomes general sales manager of the company; and FRED W. SCOTT, JR., heretofore assistant sales manager of the Coated Products Division has been advanced to sales manager of that Division.

J. M. SPANGLER, former director, vice-president, and general manager of the National Carbon Division of the Union Carbide and Carbon Corporation, New York City, has been appointed president of the Division.

J. M. Spangler, new president of the National Carbon Division, Union Carbide & Carbon Corpn.

HYDROPRESS, INC., 570 Lexington Ave., New York City, announces that the rolling mill business heretofore carried on by the LOEWY CONSTRUCTION Co., INC., of New York City, will be operated in the future as the LOEWY ROLLING MILL DIVISION of Hydropress, Inc.

WILLIAM J. VONAH, Box 667, New York Post Office Station, La Guardia Field, New York City, has been promoted to the position of New York representative for the Kropp Forge Co., Chicago, Ill. Mr. Vonah was formerly an assistant in the New York office.

AMERICAN BRAKE SHOE Co., New York 17, N. Y., announces the consolidation of all operations of its Canadian subsidiaries into one corporation, the DOMINION BRAKE SHOE Co., LTD., with headquarters at 1405 Peel St., Montreal, P. Q.

J. E. RYAN and C. P. HAYES have been appointed staff assistants to B. A. CASE, manager of engineering of the Small Apparatus Divisions of the General Electric Co., Schenectady 5, N. Y.

S-K-C RESEARCH ASSOCIATES have been organized, with laboratories at 445 Fifth Ave., Paterson 4, N. J., for research, technical consultation, and development in powder metallurgy, process and plant design, and mechanical, chemical, and metallurgical engineering.

BRIDGEPORT BRASS Co. is moving its warehouse facilities from Newark to a new and larger location at Hillside, N. J., in order to provide better service for its customers. N. H. MOSHER, district manager, will be in charge of the new warehouse.

Ohio

VAN H. LEICHLITER, previously general superintendent of the South Works in Worcester, Mass., of the American Steel & Wire Co., has been named assistant vice-president of operations, with headquarters in Cleveland, Ohio, succeeding WALTER F. MUNFORD, who was recently promoted to the position of vice-president of operations. Umbert F. Corsini formerly division superintendent of the South Works, will occupy the post of general superintendent vacated by Mr. Leichliter. CHARLES M. KAY has been appointed division superintendent to take Mr. Corsini's place.

RELIANCE ELECTRIC & ENGINEERING Co., Cleveland, Ohio, has opened a sales office in Charleston, W. Va., with WILLIAM C. MCCONNELL, a sales engineer in the Pittsburgh district for the last two years, as branch manager. The new office is located at 1206 Kanawha Blvd., East. The company also announces the appointment of JACK H. EICHLER as field sales engineer at the Boston office. Mr. Eichler has been connected with the organization since 1946 in the capacity of application engineer.

SENTRY Co., Foxboro, Mass., manufacturer of electric metal heat-treating furnaces, announces the appointment of the NORTHEAST EQUIPMENT Co. as its Ohio representative. HARLEN F. MURA and ALBERT F. FREIHEIT of the latter firm will maintain offices at 1305 W. 105th St., Cleveland, Ohio.

SIDNEY MACHINE TOOL Co., Sidney, Ohio, announces the appointment of two new dealers for its line of lathes as follows: K. C. RANDALL MACHIN-

ERY Co., 304 Strathmore, Syracuse 4, N. Y.; and WEBSTER MACHINERY Co., 3201 First Ave., South, Seattle 4, Wash.

Pennsylvania

LANDIS TOOL Co., Waynesboro, Pa., has announced the acquisition of the stock of the GARDNER MACHINE Co., Beloit, Wis. The flat surface grinding machines manufactured by the latter company will continue to be produced in Beloit under the same management, and the company will operate as a separate corporation. Officers of the Gardner Machine Co. are: M. A. HOLLENGREEN, president; W. B. LEISHMAN, vice-president and general manager; and C. WINSLOW THOMPSON, vice-president and assistant general manager.

ROBERT H. BROWN, chief of chemical metallurgy at the Aluminum Co. of America's research laboratories in New Kensington, Pa., has been chosen by the National Association of Corrosion Engineers to receive the Whitney Award for 1950 "in recognition of his outstanding contributions to the science of corrosion." The Whitney Award, international in scope, is one of the highest honors in the field of corrosion engineering. Mr. Brown has been associated with the company's research laboratories since 1931.

ALUMINUM CO. OF AMERICA has established a new division for the rolling of magnesium sheet at its New Kensington, Pa., works. Magnesium rolling operations had been conducted in the New Kensington plant in the past, but were discontinued in 1947 because of the sharp drop in demand for magnesium sheet after World War II. Greatly increased demand for airplane construction and other phases of the national security program have required the re-establishment of the division.

BIRDSBORO STEEL FOUNDRY & MACHINE Co., Birdsboro, Pa., announces the appointment of the following agents: MILLER-JOYCE, 122 1/2 S. Vermont Ave., Los Angeles, Calif.; WHITTY ENGINEERING Co., 10 High St., Boston, Mass.; and J. R. ALLEN Co., 402 Swetland Bldg., Cleveland, Ohio. The two first mentioned companies will handle hydraulic presses and the third company will handle Birdsboro steel castings.

JOHN M. MITCHELL has been appointed manager of the Export Division of the Aluminum Co. of America, Pittsburgh, Pa. He was formerly in charge of Alcoa sales in Mexico. Mr. Mitchell will make his headquarters in Pittsburgh. G. B. D. PETERSON has been named head of the New York office of the Export Division. He was previously sales representative for the company in York, Pa.

WILLIAM F. MACDONALD was recently elected president of E. F. Houghton & Co., Philadelphia, Pa., manufacturer of industrial oils, leathers, and chemicals. Mr. MacDonald succeeds MAJOR AARON E. CARPENTER, president of the company since 1934, who has been elected chairman of the board of directors. DR. JAMES T. EATON has been named director of research of the company.

WHITING CORPORATION, Harvey, Ill., manufacturer of foundry equipment, cranes, and railroad maintenance equipment, announces that its Philadelphia district sales office has been moved from the Broad St. Station Bldg. to 9 Rittenhouse Place, Ardmore, Pa.

R. A. ROOSEVELT, advertising manager of the Eriez Mfg. Co., Erie, Pa., manufacturer of magnetic separation equipment, has been promoted to the position of sales manager, replacing GEORGE R. WELLMON.

WILLIAM J. POWERS, who has been acting manager of the clad and conversion sales department, of the Lukens Steel Co., Coatesville, Pa., has been appointed manager of the department.

OLIVER J. R. TROUP, JR., has been appointed sales engineer for the Atlas Chain & Mfg. Co., Philadelphia, Pa., in the eastern Pennsylvania, New York, and Maryland sales territories.

ROY D. HAWORTH, JR., has been appointed manager of product development of the Carbide Alloys Division of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa.

ERIE MFG. & SUPPLY CORPORATION, 1215 Peach St., Erie, Pa., has been appointed distributor for the CARBOLOY COMPANY, INC., Detroit, Mich.

F. H. CLARK has been named sales manager for the Standard Control Division of the Westinghouse Electric Corporation at Beaver, Pa.

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Plant Tours During the A.S.T.E. Meeting

During the eighteenth annual meeting and Exposition of the American Society of Tool Engineers, to be held in Philadelphia April 10 to 14, inclusive, there will be plant tours to the following companies: Westinghouse Electric Corporation, Baldwin Locomotive Works, S K F Industries, Inc., Budd Co., Philco Corporation, Link-Belt Co., RCA Corporation, and Crown Can Co.

Obituaries

FREDERICK G. SCHRANZ, a consulting engineer with offices in Philadelphia and New York, died on March 5 at his home in Philadelphia at the age of sixty-nine years. Born in Austria, Mr. Schranz came to the United States as a youth, starting his career as a machinist with the Midvale Co., at Nicetown, Pa. In 1905, he became associated with the Camden Iron Works of R. D. Wood & Co. Ten years later he joined the Southwark Foundry & Machine Co. which, in 1929, became the Baldwin-Southwark Corporation, a subsidiary of the Baldwin Locomotive Works. Mr. Schranz was made general manager of the Baldwin-Southwark Corporation in 1939, and in 1942 divisional vice-president. He resigned three years later to enter private business. Mr. Schranz is survived by his wife and two daughters.

FRANK O. LINCOLN, chairman of the board of the Hy-Pro Tool Co., New Bedford, Mass., died on February 11, after a brief illness, at the age of seventy-five years. Early in his career, he was connected with the Taunton Tack Works and Atlas Tack Co. Then, for forty-five years he was a sales executive for the Morse Twist Drill & Machine Co., later becoming vice-president in charge of sales. After his retirement from the latter company, Mr. Lincoln became chairman of the board of the Hy-Pro Tool Co. During his business career Mr. Lincoln traveled extensively and had countless friends in the metal-working and hardware industries from coast to coast.

COLONEL WILLIAM WATTS ROSE, formerly executive vice-president of the Gray Iron Founders Society, Inc., Cleveland, Ohio, died on February 20 at the age of sixty-six years, and was buried with military honors at Arlington Cemetery, Washington, D. C. Colonel Rose did much to build up the Society, having been executive vice-president for ten years, and his passing is considered a great loss by its members.

FRANK A. LUEBBE, vice-president and general sales manager of the Nichols Wire & Aluminum Co., Davenport, Iowa, died on March 9 at the age of fifty-six years. Mr. Luebbe was born in Cincinnati, Ohio, on October 10, 1893, and was educated in that city, being graduated from St. Joseph College. He was widely known as a sales executive in the steel industry and later in the aluminum industry.

WILLIAM PHILIP SIEG, founder and former president of the Titan Metal Mfg. Co., Bellefonte, Pa., died on January 27.

Coming Events

April 5-7—Twelfth annual Midwest Power Conference at the Sherman Hotel, Chicago, Ill. Sponsored by the Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, Ill.

April 10-12—Fifth annual convention of the American Society of Lubrication Engineers at the Hotel Statler, Detroit, Mich., in conjunction with the third annual Lubrication Exhibit of the Society. W. F. Leonard, secretary-treasurer, Chicago 4, Ill.

April 10-14—Exposition of the American Society of Tool Engineers at the Convention Hall and Commercial Museum in Philadelphia, Pa. Details available upon request to the Exposition headquarters of American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

April 12-14—Spring meeting of the American Society of Mechanical Engineers at the Hotel Statler, Washington, D. C. Clarence E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

April 14-15—Eleventh annual Ohio State Welding Engineering Conference at Ohio State University, Columbus, Ohio.

April 20-21—Fifth annual Time Study and Methods Conference at the Hotel Statler, New York City. Sponsored by the Society for Advancement of Management and the American Society of Mechanical Engineers. For further information, address Society for Advancement of Management, 84 William St., New York 7, N. Y.

May 3-4—Twenty-first annual Welding Conference and Welders' Institute and Exhibit at Purdue University, Lafayette, Ind.

May 25-27—Spring meeting of the Society for Experimental Stress Analysis at the Hotel Statler, Cleveland, Ohio. Address inquiries to the Society, Box 168, Cambridge 39, Mass.

June 1-2—Fourth national convention and fifth Midwest Conference of the American Society for Quality Control in Milwaukee, Wis. Further information can be obtained by writing to the Fourth National Convention, Fifth Midwest Conference, Box 1204, Milwaukee, Wis.

June 19-23—Semi-annual meeting of the American Society of Mechanical Engineers at the Statler Hotel in St. Louis, Mo. Secretary, Clarence E. Davies, 29 W. 39th St., New York 18, N. Y.

June 26-30—Annual meeting of the American Society for Testing Materials and Ninth Exhibit of Testing Apparatus at the Chalfonte-Haddon Hall, Atlantic City, N. J. Executive secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

September 26-29—Iron and Steel Exposition, in conjunction with the annual convention of the Association of Iron and Steel Engineers, at the Cleveland Public Auditorium, Cleveland, Ohio. For further information, address the Association, 1010 Empire Bldg., Pittsburgh 22, Pa.

October 18-20—Annual national conference of the Society of the Plastics Industry, at New Ocean House, Swampscott, Mass. Further information can be obtained from William T. Cruse, executive vice-president, 295 Madison Ave., New York 17, N. Y.

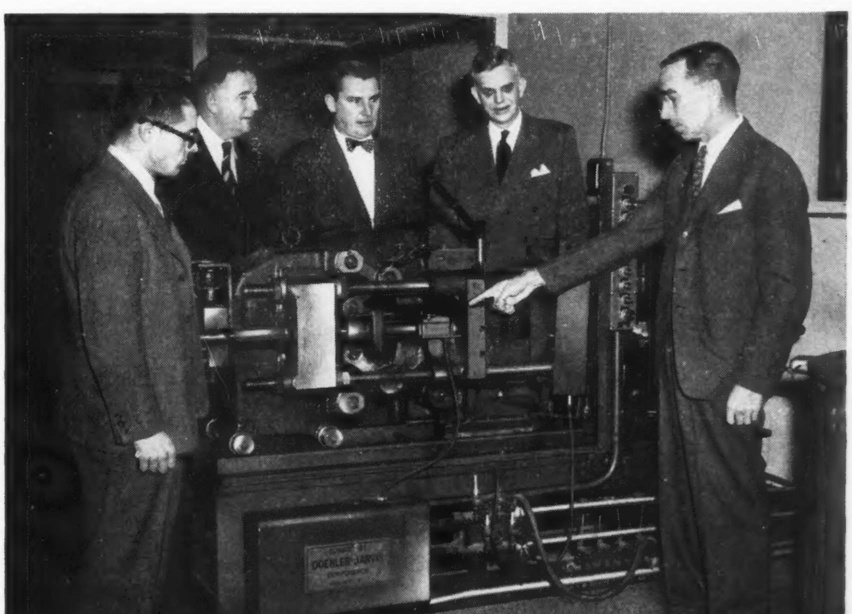
October 23-27—Fall meeting of the Metals Branch of the American Institute of Mining and Metallurgical Engineers in Chicago, Ill. National secretary, E. H. Robie, 29 W. 39th St., New York 18, N. Y.

October 23-27—Annual meeting of the American Society for Metals in Chicago, Ill. National secretary, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

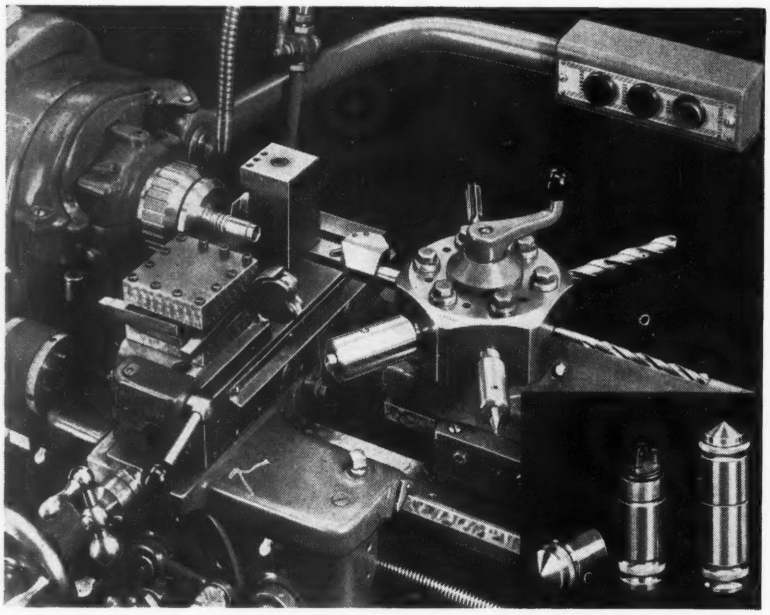
October 23-27—Annual meeting of the American Welding Society in Chicago, Ill. National secretary, J. G. Magrath, 33 W. 39th St., New York 18, N. Y.

October 23-27—Annual meeting of the Society for Non-Destructive Testing in Chicago, Ill. National secretary, Philip D. Johnson, Skokie, Ill.

October 23-27—National Metal Congress and Exposition at the International Amphitheatre, Chicago, Ill. For further information, address W. H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.



Fully equipped die-casting machines have recently been donated to four outstanding schools of technology by the Doehler-Jarvis Corporation. The illustration shows one of these machines being presented to the Illinois Institute of Technology. T. H. Pickering, vice-president of Doehler-Jarvis Corporation, is seen explaining the operation of the machine to Professor Otto Zmeskal, Illinois Institute of Technology; J. C. Fox, chief metallurgist, and J. W. Thees, Chicago plant manager, both of the Doehler-Jarvis Corporation; and Dr. H. T. Heald, president of the Illinois Institute of Technology



South Bend turret lathe set up for machining bodies for cigarette lighters shown in insert

Cigarette Lighters to be Manufactured at Tool Engineers' Exposition

As part of their exhibit at the Tool Engineers' Industrial Exposition in Philadelphia, the South Bend Lathe Works, South Bend 22, Ind., will demonstrate their Series 1000 precision turret lathe in operation manufacturing parts for cigarette lighters.

The case for the cigarette lighter is machined from aluminum bar stock, which is fed through a hand-lever operated collet by a pneumatic bar feed. The hexagon turret carries five tools, in addition to the stock advance stop. The tools include a centering drill, first drill, size drill, reamer, and inside chamfering tool. The screw-feed double tool-slide is equipped with a square tool-block and a rear tool-block. The square tool-block carries four tools—a neck-turning tool, a body-turning tool, a knurling tool, and a forming tool. The lengths of the turning cuts are controlled by a four-position carriage stop. The rear tool-block carries the cutting-off tool. A coolant pump supplies coolant for all operations.

After the lighter case is cut off, it is finished in a 9-inch South Bend quick-change-gear lathe. A pot collet holds the piece for the bottom facing and chamfering operation. Close tolerances are held, so that parts are interchangeable and can be quickly assembled to complete the cigarette lighters, which will be given as souveniers to visitors at South Bend Booth No. 923.

Course in Tool Steels Offered at Stevens Institute

A course in tool steels is now being given in connection with the metallurgy program of the Industries Training School at Stevens Institute of Technology in Hoboken, N. J. T. G. Gilley, metallurgist for the Western Electric Co., is the instructor. Mr. Gilley has instructed apprentice tool and die makers in the proper selection and heat-treatment of the materials used. The course deals with the properties, composition, and heat-treatment of tool steels, including precautions to prevent warping and distortion. The processing as well as the must suitable application of each type of steel will be described in detail. The lectures will be supplemented with laboratory demonstration and experiments.

Machine Tool Electrification Forum

The 1950 Westinghouse Machine Tool Electrification Forum will be held in Buffalo, N. Y., on April 25 and 26. The first day's session will be at the Hotel Statler and the sessions of the second day at the Buffalo plant of the Westinghouse Electric Corporation.

The following papers will be presented on the morning of the first day: "The Use of Carbide Cutting Tools and Their Effects on Motor Requirements," by E. K. Morgan, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.; "Automatic Cycling and Programming as Applied to Single-Spindle Automatic Screw Machines," by Ralph Shuman, Warner & Swasey Co., Cleveland, Ohio; "A New Facet to a Dynamic Equipment Policy," by L. W. Scott Alter, American Tool Works Co., Cincinnati, Ohio; and "Electronic Devices as Components of Machine Tool Control," by Jack Morgan, Cincinnati Milling Machine Co., Cincinnati, Ohio.

Following luncheon there will be a report of the Electrical Committee of the National Machine Tool Builders' Association presented by its chairman, W. B. Wigton of the Giddings & Lewis Machine Tool Co. Then a discussion of specifications of the Joint Industry Conference will be presented by representatives of the Chrysler Corporation, the Ford Motor Co., and the General Motors Corporation. Nels Bashor of the W. F. & John Barnes Co., Rockford, Ill., will lead a discussion on the use of stranded wire in the machine tool industry. An open forum discussion will conclude the afternoon program.

The program of the second day comprises the following papers: "Constant Cutting, an Old Problem—A New Approach," by R. C. Montanus, Springfield Machine Tool Co., Springfield, Ohio, and E. B. Ankenmann, Westinghouse Electric Corporation; "Broadening the Use of Standard Electrical Equipment on Machine Tools," by O. G. Rutemiller, Morton Mfg. Co., Muskegon Heights, Mich.; and "D-C Dynamic Braking of Induction Motors," by F. D. Snyder, Westinghouse Electric Corporation. Open forum discussions and plant inspection trips will be other features of the day.